WORLD PETROLEUM

OCTOBER 1960

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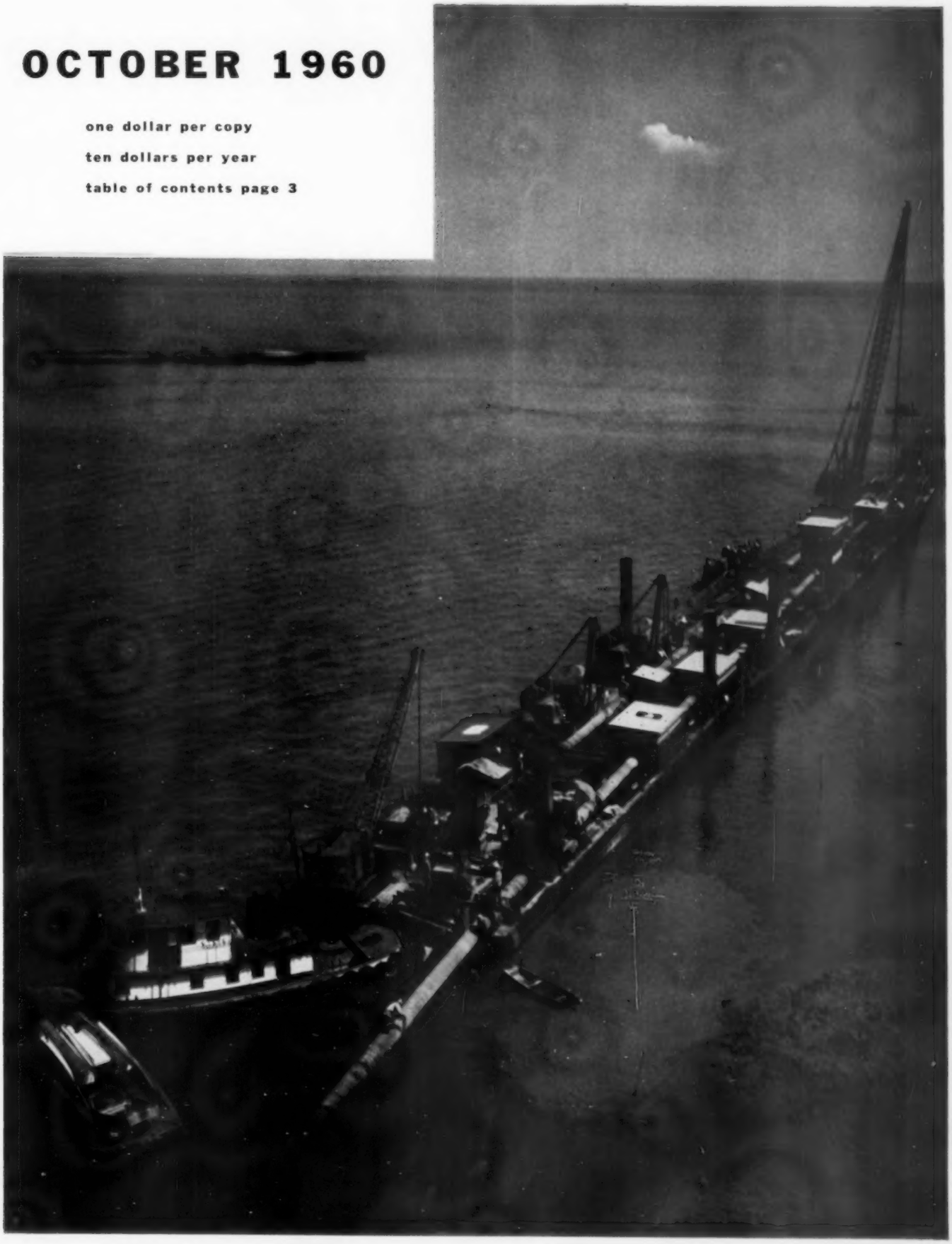

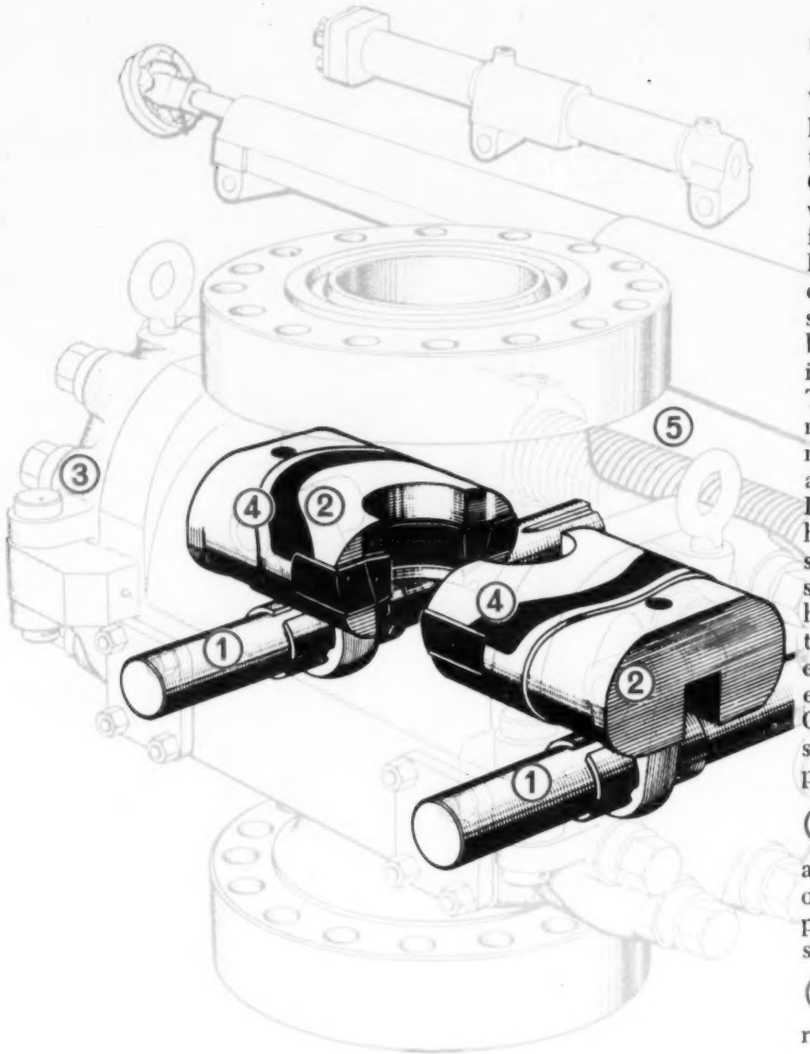

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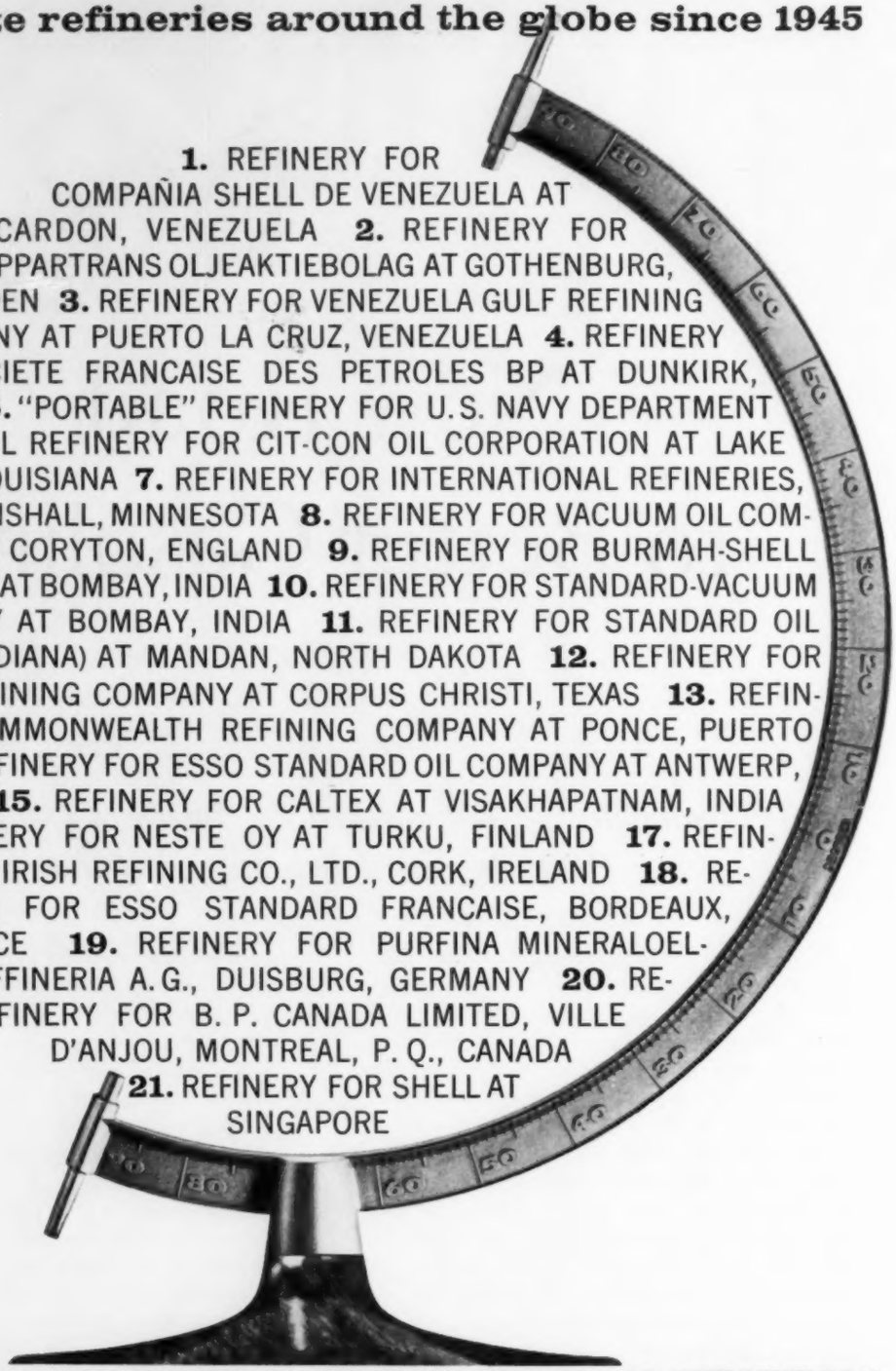

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THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

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THIS MONTH'S COVER

Double barge 400 feet long used by Williams Brothers, Tulsa, in laying submarine pipelines. The barge was first used to lay Tennessee Gas Transmission Company's "Muskrat Line" in southern Louisiana. Color photograph is reproduced through courtesy of Williams Brothers and Al Smith, editor of *The Line*, Tennessee Gas Transmission's house magazine.

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by Joseph B. Huttlinger

Oil Sells at Loss

The U. S. oil producer is losing about 38 cents each time he sells a barrel of crude oil. That's the surprising finding of the U. S. Bureau of Mines in a massive 1,000-page book entitled "Mineral Facts and Problems," prepared for the bureau's 50th anniversary.

The bureau says the "industry's present replacement cost per barrel of crude oil is $3.38." And, it adds, "the average selling price of crude oil in the United States in 1958 was $3.03 per barrel." Since then, the price has dropped to $3 a barrel according to industry figures.

The bureau says its replacement cost figure is based on studies by the American Petroleum Institute, Independent Petroleum Association of America, Mid-Continent Oil and Gas Association, Carter Oil Co., and C. C. Anderson, chief petroleum engineer of the bureau.

The bureau sees the world with a surplus of crude oil today and even more in the years to come. U. S. producers can step up output by 30%, the bureau explains. It adds that worldwide, producers can add more than "five million b/d above the present production of 18 million b/d."

It goes on: "The outlook for increased supplies is excellent, both in the United States and the rest of the world" so "oil will be plentiful for the next 15 or 20 years in spite of a great increase in demand." If needed, there is oil from coal and oil shale, the bureau points out. The demand rise in the U.S. is expected to be from 9.1 million b/d in 1958 to 17 million b/d by 1975, an annual growth rate of 3.71%, the bureau explains. Outside the U.S., the rate of growth will be faster.

Oil Labor Faces Cleanup

A labor union of oil workers is the first to be caught up in the government's new legal powers to enforce clean elections in unions. The Independent Petroleum Workers of Bayway, N. J., has been hailed into the U. S. District Court by Secretary of Labor James P. Mitchell.

Mr. Mitchell said an election of Feb. 19 violated certain clean election provisions of the Labor Management Reporting and Disclosure Act of 1959. He asked the court to set aside the election and to order another under Mr. Mitchell's supervision. In the election, John J. Coppa was re-elected as president, defeating John Sullivan. The union represents workers at the Bayway refinery of Humble Oil & Refining Co.'s Esso Standard division.

Depletion To Be Studied Again

Signs are that the income tax depletion allowance for crude oil and natural gas production is headed for a full scale study by Congressional tax writers during 1961. Now, platforms of both the Democrats and Republicans have covered the subject, lending impetus to the drive for an allout study.

The platforms seem to say something until you study them closely. Upon study, it seems that they are pretty much the same. Thus, the Republicans, too, seem to be against "inequitable depletion allowances" according to their stand for "reasonable" allowances. Conversely, the Democrats can be inferred to be for "reasonable" allowances.

So, the words leave plenty of room for argument as to whether either or both parties feel oil's depletion is too high, or too low.

Here is how the parties line up on other issues:

Small business—The Democrats are for more credit and other steps to help small business. The Republicans are for "fostering new and small business."

Antitrust laws—The Democrats are for stiffer enforcement, a stronger law to curb price discrimination, and steps to allow the Federal Trade

Pipeline

Commission to obtain temporary injunctions against certain business practices. The Republicans are for "continued active enforcement."

Highways—Both parties are for continuing the national interstate highway program at a high rate of activity.

Auto exhaust gas—The Democrats are for more research to cut down on air pollution from auto exhausts. The Republicans are silent on this.

Fuels policy—The Democrats are for establishment of a national fuels policy backed by coal industry. The Republicans are for "long range minerals and fuels planning and programming, including increased coal research."

Presidential Candidates' Views on Oil

The U.S. oil and gas industry sees the presidential election next month as a choice between two men whose views on major oils and gas matters are generally on opposite sides.

Thus, Sen. John F. Kennedy, of Massachusetts, the Democratic nominee, voted against a bill to ease up federal price and other controls over natural gas producers. He voted to slash the 27.5% depletion provision on a sliding scale to 15%, but against a flat reduction to 15%.

During the primary campaigns a few months ago, he came out for creation of a national fuels policy, as asked by coal men but bitterly opposed by oil and gas leaders.

He voted against the tidelands bill in 1953 to give coastal states some of the offshore oil and gas at a time when many oil industry leaders favored the measure. And, he has dropped hints that he likes plentiful oil imports.

Vice President Richard M. Nixon, the Republican nominee, on the other hand, voted for a gas bill when he was a member of the U.S. House of Representatives. He voted for the tidelands bill. He recently called the 27.5% depletion provision reasonable. He has been silent about a national fuels policy. He is believed in favor of the present oil imports program.

The platforms of each party also carry clues as to what's ahead if either man is elected. The Democratic platform seems to favor lowering the oil and gas depletion, although it does not clearly say this. The Republical platform seems to be in favor of the present rate. The Democratic platform also calls for creation of a fuels policy, but the Republican document is silent on this. Neither calls for a natural gas bill, the major need of oil and gas; neither mention the oil import program.

Gasoline Sales Declining?

Federal gasoline tax collection figures indicate a drop in gasoline consumption in the first half of this year compared to a year ago. Internal Revenue Service reports collections of $1,081 million in gasoline taxes in the first half of this year. The rate of tax has been four cents a gallon since October, 1959.

For the first half of last year, the collections came to $811 million, a period when the federal gasoline tax was three cents a gallon. Translated into gallons, this represents sale of 27,019 million gallons of gasoline this year and 27,024 million gallons a year ago.

The federal tax collection figures in theory at least are a measure of the vast bulk of all gasoline sold in the U.S., as most of it is sold through gasoline stations and for highway use and subject to the federal tax.

U.S. Bureau of Mines, meanwhile, reports gasoline production in the first half of this year was 31,629,654,000 gallons, against 30,736,188,000 gallons a year earlier. Retail sales in terms of dollars of gasoline stations this year are running five to six percent ahead of those of a year ago, which seems at odds with the IRS figures.

(*Continued on page 6*)

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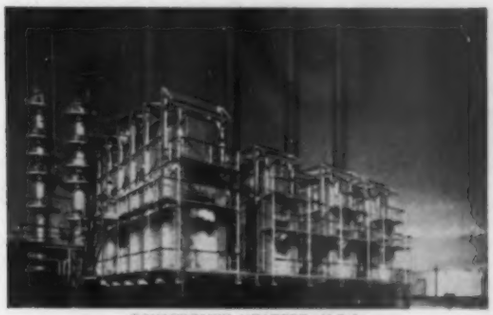

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Asphalt Use Grows

The USA market for asphalt, which is estimated at about 325,000 b/d this year, faces a steady growth of about 4% a year over the next decade, it is estimated. By 1970, therefore, USA demand will be up 50% to a total of about 489,000 b/d.

The figures are set forth in an analysis of the asphalt supply-demand outlook prepared by Stanford Research Institute, Menlo Park, Calif. It was prepared at the request of Atlantic Refining Co., Cities Service Oil Co., Standard Oil Co. (Ind.) and Standard Oil Co. (Calif.). The four are among companies seeking exemption of asphaltic content of crudes from oil import controls.

The study foresees both more total highway construction, rising from $9.6 billion this year to $13.9 billion by 1970, and more use of asphalt in these highways.

In the period 1953 through 1957, the study says, the use factor for bituminous materials climbed 15% in highways, while Portland cement dropped 3%.

"The asphalt use factor is expected to continue to increase slowly," it explains, due to "increasing thickness" needed to support heavier vehicles.

The U.S. now relies upon foreign sources for 28% of its asphalt, the study shows, including 19,000 b/d of finished asphalt imported and 57,000 b/d from imported asphaltic crudes.

For District one, the U.S. East Coast, the reliance is as heavy as 75%, including 14,000 b/d of finished asphalt and 50,000 b/d of imported asphaltic crude oil, or a total of 64,000 b/d in 1958.

The study sees a need for continued imports today if demands are to be met at a reasonable price, and for even larger imports in years to come. Most of the rest of the USA, however, can rely chiefly upon domestic sources for years to come, the study indicates.

If imports were cut off today, the study says, the East Coast could find only an extra 40,000 b/d of asphalt from crudes available domestically and from Canada. All of this would be at an increased price averaging $4 to $5 a barrel for asphalt. The extra cost would be $6 to $7 on the basis of Venezuelan crudes, the primary source of asphalt for the East Coast, the study goes on.

Without the oil imports program, the study points out, imports of finished asphalt and asphaltic crude to the East Coast would be 65,000 to 70,000 b/d in the years 1960 through 1962, some 85,000 b/d in 1965 and 120,000 b/d in 1970. So, imports would account for all of the increase in demand.

Filing the document with the Office of Civil and Defense Mobilization, the four companies jointly asked "decontrol" of the asphaltic content of imported crude and unfinished oils under the oil imports program. The OCDM at once undertook a study.

Charter Rates Look Up

A sudden spurt out of the doldrums in the USA oil tanker market was registered recently with a jump to $2.85 per ton from $2.10 in the Port Arthur, Texas, to New York charter rate. Though even higher rates are expected, oil men appear skeptical that this augurs an early or steady stiffening in the USA market or a tightening of world tanker rates. The recent increases have resulted from an unexpected shortage of tankers which can haul so-called clean cargoes. Some 50 USA tankers have been laid up for lack of cargo, and 15 others have switched to hauling grain overseas. This suddenly produced a temporary shortage of tankers for hauling refined oil products, resulting in charter rates at their best summer level in several years.

No Gas Import Strings

The FPC now permits three USA companies to import 584.5 mmcf/d of natural gas from Canada's Alberta fields; and the approval omits some of the stricter requirements of the FPC examiner who previously had requested approval on condition the USA importers and Canadian suppliers keep the FPC informed on price factors so the agency could protect USA consumers, a requirement at which Alberta's provincial government and others balked.

Pacific Gas Transmission Co., a proposed new interstate pipeline, will buy 418 mmcf/d for distribution in California by Pacific Gas & Electric Co. (owner of 50% of the new company's stock). El Paso Natural Gas will bring in 136.5 mmcf/d for sale primarily in Washington, Oregon, and Idaho; and Montana Power Co., Butte, will get the other 30 mmcf/d for its system's use.

To Visit Russia

Eight USA oil-executives, accompanied by Russian-speaking oil and gas specialists from the US Department of Interior, left during August for a month-long official inspection of Russian installations. The team was to visit refineries in various parts of the USSR, offshore drilling in the Caspian Sea, and Baku oil-field operations. Plans called for the Russians to send a reciprocal delegation to look over USA oil operations in September or October.

USA oil executives on the Russian inspection team include W. W. Keeler, executive vice president of Phillips Petroleum, Bartlesville, Okla.; Ira H. Cram, senior vice president of Continental Oil Co., New York; George S. Dunham, a Socony Mobil Oil director, New York; W. W. Elias, vice president of Pan American Petroleum, Tulsa; George F. Getty, president of Tidewater Oil, Los Angeles; George T. Pierce, head of petroleum economics for Standard Oil (New Jersey), New York; Neal J. Smith, vice president of Chevron Oil, Houston; Dr. Noyes D. Smith, Jr., vice president Shell Development, Houston.

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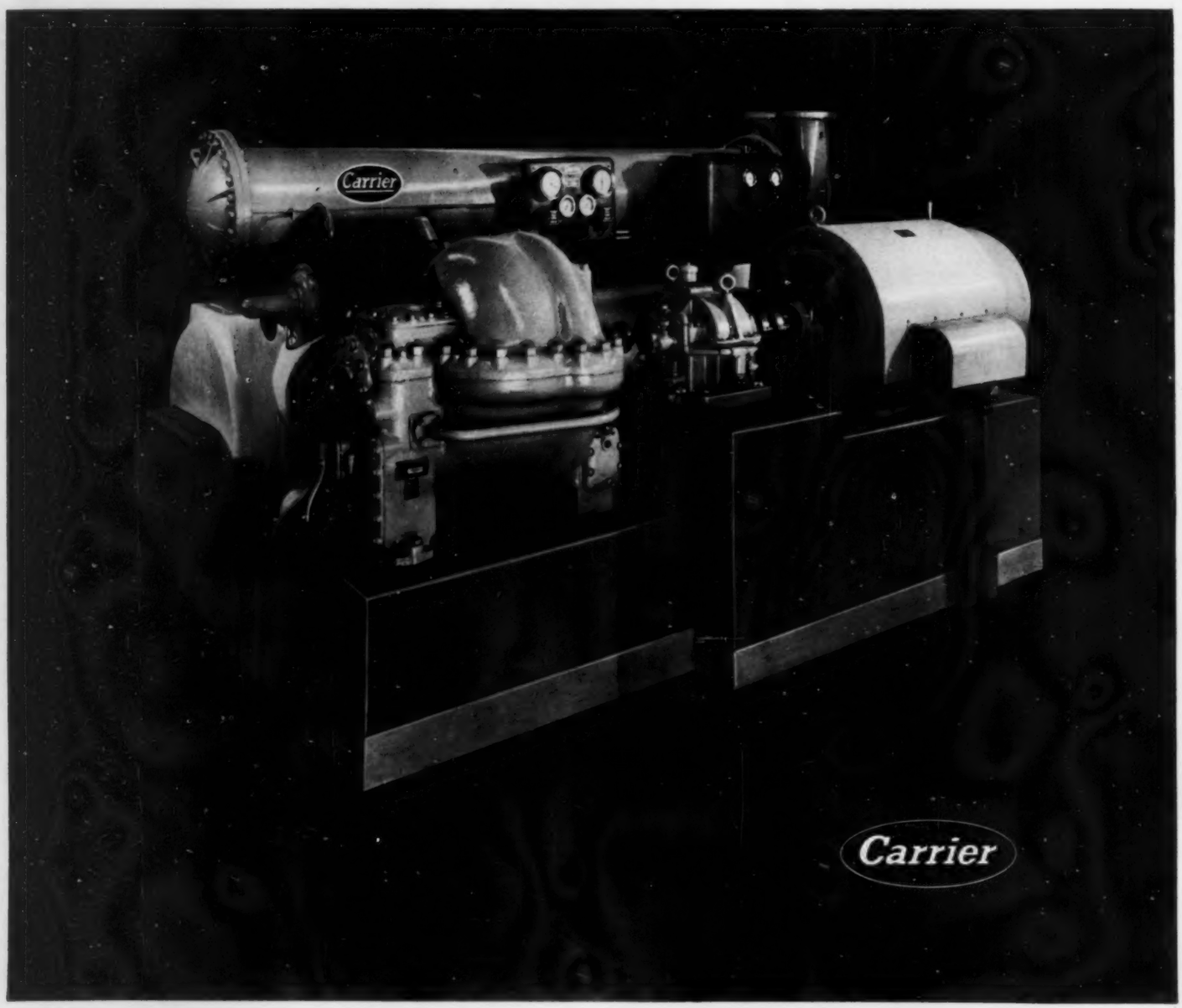

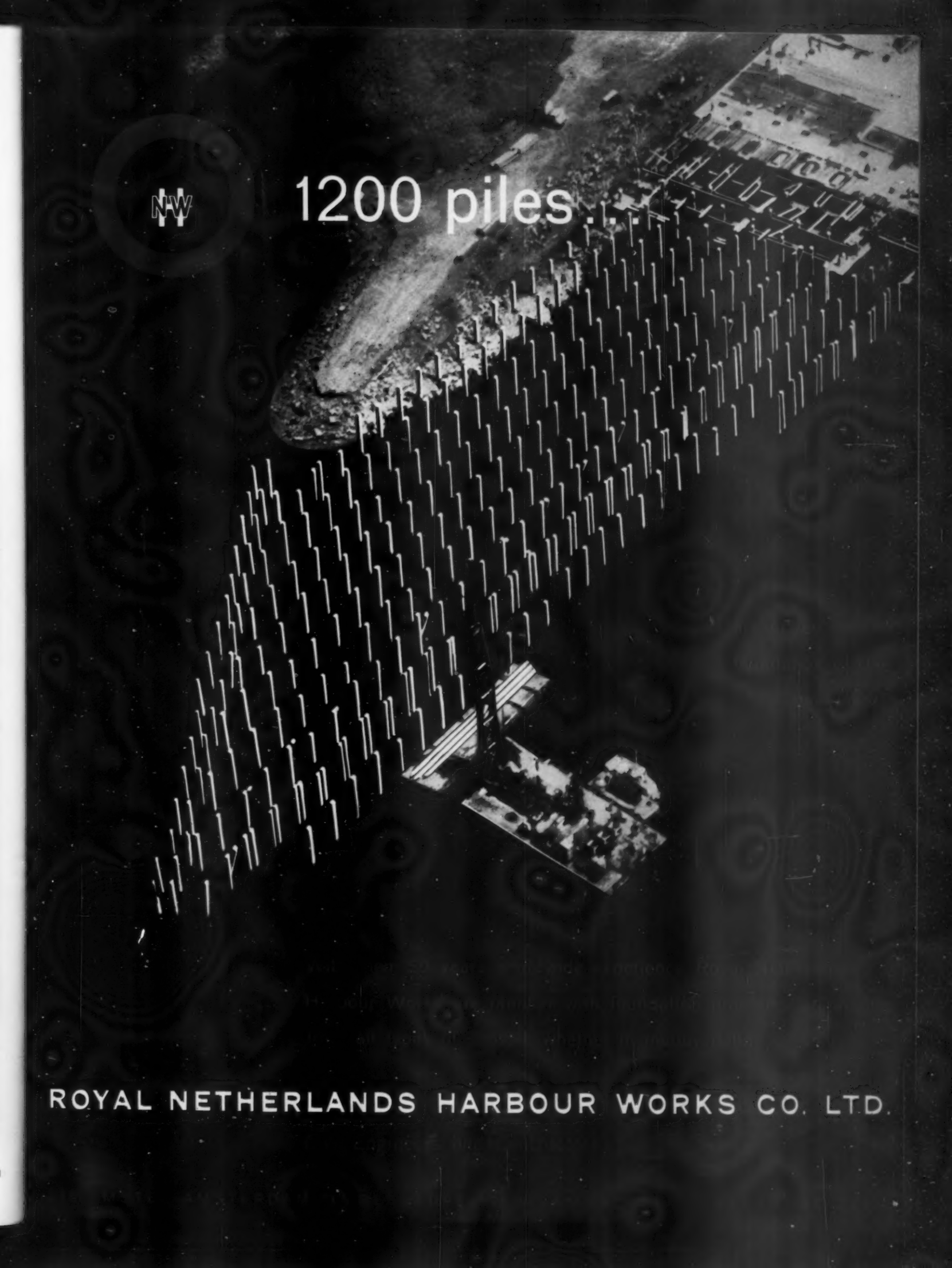
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Imports Rise 10.2% in the Half-Year

With publication of the figures for the half-year, the picture of 1960 UK oil trade is emerging. The total imports of 215,252,000 bbl (1,182,700 b/d) represent a rise of no less than 19,994,000 bbl (10.2%) over the first half of 1959. Crude oil imports were higher by 11,324,000 bbl (7.6%), while the rise in fuel oil was unprecedented at 11,094,000 bbl (66.8%). Summarized details for these periods are as follows:

UK Imports/Exports January to June

	Quantity in 1,000 bbl		Value in £ million	
	1960	1959	1960	1959
Imports:				
Crude oil	160,539	149,215	165.0	164.7
Refined oil—				
Motor spirit	11,569	10,867	21.4	20.6
Spirit, other than motor spirit	1,125	487	1.8	1.2
Kerosine	2,913	6,153	5.0	11.2
Lubricating oil	1,977	1,858	6.9	5.3
Gas oil	9,077	8,807	13.8	15.2
Diesel oil	341	1,255	0.5	1.9
Fuel oil	27,711	16,617	27.3	17.3
Total	54,713	46,043	76.8	72.6
Crude and refined	215,252	195,258	241.8	237.3
Exports:				
Total liquids	33,631	28,697	49.4	45.1

Although the quantity consigned from the Middle East has risen to 133,325,000 bbl (£135.6 million) from 119,734,000 bbl (£131.7 million), the proportion is relatively unchanged at 61.9% against 61.3%.

A decline of 4.3% is to be seen in the half-year's unit cif value of crude oil as compared with the 1959 average—to 7.05 d/imp gal from 7.37 d. Refined products as a whole show a drop of 8.6%—to 9.62 d/gal from 10.53d.

Refinery throughput has averaged 3,443,500 (long) tons over the first four months of the year, an increase of 182,200 tons (5.6%) over the 1959 monthly average of 3,261,300 tons. An index of the higher level of petrochemical production is to be seen in the fact that deliveries of feedstock for such plants averaged 123,400 tons, a rise of 34,500 tons or no less than 38.8% over the 1959 average of 88,900 tons.

Total deliveries of petroleum products for inland consumption over the first five months, with a monthly average of 3,325,200 tons, are above the 1959 average of 2,786,300 tons by 538,900 tons (19.3%). The rise for fuel oil alone was 387,400 tons (33.7%), the monthly average this year of 1,538,400 tons comparing with 1,151,000 tons over 1959.

Esso to Build Butyl Plant

Esso Petroleum Co. will build a £4.3 million butyl rubber plant at Fawley with a capacity of 30,000 ton/yr. It is expected to take two to three years to complete and to be adequate to meet all UK requirements for a considerable period as well as supplying a surplus for export. At present all butyl rubber is imported from the USA and Canada. In the first half of this year synthetic rubber imports totalled 33,730 tons (value £7,640,107) against 16,900 tons (£3,975,170) in the same period of 1959. Exports of synthetic and reclaimed rubber rose in these periods to 14,663 tons (£2,160,238) from 6,900 tons (£804,006).

Leeds SMBP Installation Expansion

Shell-Mex and B. P. is starting work in September on a £250,000 extension which will more than double the capacity of its Leeds installation. Twelve large tanks and ancilliary equipment will be built on a 10-acre site.

Detection of Mill Scale

A quick, simple and inexpensive method of checking the completeness of mill scale removal from steel plate before painting has been developed by "Shell" Research Ltd. as a result of its work on tanker protection.

It has been found that the application of a copper sulfate solution by an impregnated pad or sponge to the freshly shot-blasted surface can quickly give a guide to the effectiveness of the blasting. Areas entirely free of mill scale become coated with copper, while any scale shows up as a dark area against the copper background. The method has shown clearly how often a surface that appears clean to the eye can still be covered with enough residual scale to reduce the protection afforded by paint.

Study Tie-in Petrol Retailing

The President of the Board of Trade has decided to refer to the Monopolies Commission the question of the "solus site" or "tied garage" system of UK retail petrol sales for investigation and report as to whether it is against the public interest. The terms of reference of this inquiry have still to be announced, and it is likely to be a very considerable time before this matter is reported on: even then, it is the Board of Trade President who decides what action, if any, shall be recommended to the government.

It is generally reported that well over 90% of retail outlets have contracted to sell only one company or group's brands of petrols, and for some time there has been public propaganda by certain lubricating oil distributors, through the Motor Accessories Manufacturers' Association, against alleged obstacles to the display and sale of their products at "tied" stations.

Anglo-American Plastic Group

Shell International Chemical Co., London, and National Distillers & Chemical Corporation, New York, are forming a joint company for the development of plans for producing and marketing polyolefin film and plastic packaging materials outside the USA and Canada. National Distillers is one of the world's largest polyethylene producers and it has recently set up a Swiss company to cover sales and development.

The new company will operate from London under the control of Dr. W. L. J. De Nie, currently a Shell Development Co. senior executive in New York, and his deputy will be Werner T. Meyer, now in charge of the foreign operations of Kordite Co., a National Distillers' subsidiary.

Good Pull-up for Airmen

One of the first petrol service stations to combine facilities for small light aircraft with a main road garage has been set up in Norfolk and it is now one of the busiest in East Anglia. Already over 50 machines have landed and been refuelled with BP aviation fuel by a special long-boom pump. Shell-Mex and B. P. is considering the provision of similar facilities for light aircraft and helicopters at garages in certain areas where suitable landing places can be made alongside.

Mobil Petrol with "Tetramel"

Since mid-August motorists in the UK have been the first outside the USA to be able to use a Mobil Oil gasoline incorporating "Tetramel"—tetramethyl lead (TML). This anti-knock additive developed by the company is replacing TEL but, for the time being owing to supply problems, only in the top grade fuel—"Super Mobilgas Special." For over a year TML has been used to replace TEL in Mobil gasoline in certain USA areas. Tests have shown it to be more effective than TEL and intermediate lead alkyls in overcoming the problem of road octane depreciation in the middle range of catalytic reformates through their uneven vapor distribution in engine manifolds.

Expansion of Nylon Production

Imperial Chemical Industries is adding to its production capacity for nylon polymer. Its existing plants, and the one at present under construction, are designed to produce nylon 66 polymer, but this latest extension, costing £10 million and with 15,000 tons/yr capacity, will produce caprolactam. This is a monomer for nylon 6 polymer not hitherto made in Britain.

Higher Octane Ratings

Judged by octane rating alone, further overall improvement in the average quality of gasolines marketed in the UK is indicated by the June 1960 amendment sheets to Shell International Petroleum's booklet "Motor Gasoline Quality: A World-wide Survey of Anti-knock Data" (October 1959). Current UK levels are:

	Octane No.		TEL Content	
	Research	Motor	cc/USgal	cc/litre
Grade—				
Super premium	101	88	1.4	0.4
Premium	96	84	1.3	0.3
Regular	83	78	1.5	0.4

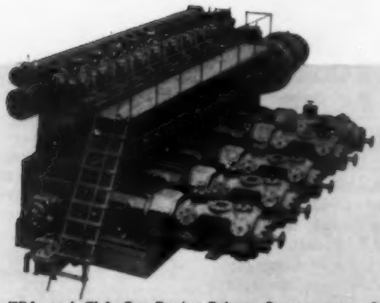
Previously the rating for super premium was 100 octane research (88 motor-no change) and that of the regular grade 82 research (77 motor).

A New Rear Axle Oil

A new synthetic worm axle lubricant—"Shell Dentax W"—has been put on the market after extensive independent testing, including 16 months' tests with 43 Bristol Transport Department's buses covering nearly 1½ million miles. These showed an overall saving of 1.6% fuel consumption through reduction in friction. In the cold winter months the saving was 2.5% to 3.0%. A further saving in operating costs was found as the period between oil changes was three to four times longer than with the previous axle lubricants used.

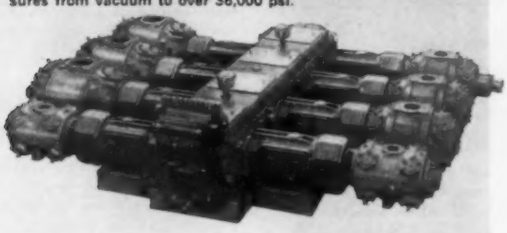
This new lubricant is made from petroleum-base materials by a patented process developed at Shell's Thornton research center. It incorporates a special

(Continued on page 12)

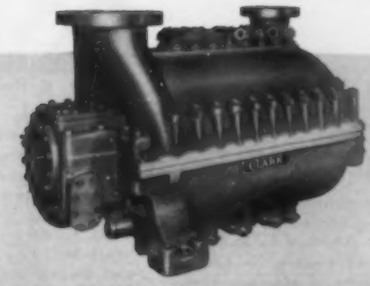


Models TRA and TLA Gas-Engine-Driven Compressors—2-cycle, turbocharged. Ideal where large blocks of horsepower are required. They offer maximum power per unit of floor space, as well as excellent fuel economy. Model TRA is available with 6, 8, and 10 cylinders, 1100 to 1800 bhp. Model TLA is available with 5, 6, 8, and 10 cylinders, 1700 to 3400 bhp.

RECIPROCATING



Models CLBA, CLRA, CJA, CMB, CMA and CFA Motor-Driven Compressors for heavy duty process applications. These balanced/opposed compressors are built in seven stroke sizes—6", 8", 8¾", 11", 14", 17" and 19". Available with 2 to 10 compressor cylinders depending on model chosen. Pressures from vacuum to over 36,000 psi.



Type HS Horizontally-Split Centrifugal Compressors are highly dependable multi-stage units used extensively in petroleum processing. Seven case sizes are available in capacities ranging to over 150,000 cfm. Up to ten stages of compression in a single case. Cooled or uncooled types available to meet process requirements.

CENTRIFUGAL

Type VS Vertically-Split Centrifugal Compressors are multi-stage units designed for extremely high pressures—to over 5,000 psig. Four case sizes have a capacity range from 200 discharge cfm to 20,000 suction cfm. Barrel-like outer case provides maximum strength. Inner case is horizontally split for easy accessibility

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Piazza Cavour, 3, Milan, Italy

oxidation inhibitor which is claimed to give it remarkable stability; even when oxidized for long periods under exceptionally severe conditions it thickens only very slightly. Its characteristics include a specific gravity at 60F of 1.025, viscosity index 140, and pour point minus 25F.

New Mobil Depot at Barry

Mobil Oil Co. has started construction of a new 5,000-ton bulk terminal at Barry Docks (South Wales) for gasolines and gas/diesel oils fed by coastal tankers from Coryton (Essex) refinery. Distribution, expected to start mid-1961, will cover South Wales and parts of Herefordshire and Gloucestershire.

CBMPE Mission Reports on Argentina

The report of the Council of British Manufacturers of Petroleum Equipment's "exploratory mission" to Argentina and Chile in March 1960, led by E. F. E. Howard (sales director, Hayward Tyler & Co. Ltd.), has now been published. Its terms of reference were to introduce the potential of the British equipment industry to the state-owned oil industries and operating companies in these countries, to investigate the opportunities available for capital goods, and to discuss the possibility of credit facilities if these were required.

The report will afford no pleasure to British manufacturers but at least its frankness will serve good purpose in dispelling any misconceptions that may still exist. The general summary is that in both countries the key word is "credit" and the main potential customers require terms which cannot at present be met by the British authorities under the payment terms desired. Thus the problem is fundamentally one on which a view has to be taken.

The mission's view is that if Britain considers political and economic risks are too great, the only alternative is to wait until conditions improve. By that time trade opportunities may well be lost irretrievably, particularly bearing in mind the possibility of strong demand for heavy capital equipment in Latin America over the next 10 years or so but it will subsequently become more and more difficult to export any manufactured goods to the area. If, however, the view is taken that the long-term economic and political stability of these countries, especially Argentina, is bound to improve, then action is necessary, and it is hoped that a change of heart and policy should not be delayed by the government, the foreign office, treasury, board of trade, and banks, etc.

Other mission members were L. S. Dawson (managing director, The Oil Well Engineering Co. Ltd.), E. G. Goodrich (sales manager, Stewards & Lloyds' oil division), and D. S. Barwell (Central and South American representative of Newman, Hender & Co. Ltd. and other companies). The report is available from CBMPE, 2 Princes Row, London, SW1, price 12s.6d. net.

J. E. H. Davies

C. H. W. Smith

Appointments

J. E. H. DAVIES and **C. H. W. SMITH,** general managers of the market department and the supply and development department respectively, have been made directors of BP Trading Ltd.

J. C. G. BOOT has been appointed a director of Bataafse International Petroleum Mij NV and has resigned from the board of Shell International Petroleum. As Royal Dutch/Shell group personnel coordinator, he will now have his office in The Hague and not in London.

EDWIN BADEN becomes chairman of Matthew Hall and Co. in place of the late Bertram Baden and has resigned as managing director. **R. R. BADEN** becomes deputy chairman and other changes are that **P. D. DOULTON** and **S. KINDLER** become managing directors and **R. M. SPEIR,** MP, has been made a director.

E. F. E. Howard

B. J. Storrar

N. E. F. HITCHCOCK, J. ROMNEY and **G. H. J. SIMMONS,** senior executives in Castrol group's research and technical departments, have been made directors of Edwin Cooper & Co., the subsidiary which specializes in producing lubricating oil additives and other chemicals. **BASIL J. STORRAR,** after some years with Castrol in managerial posts in Germany and Switzerland, has been appointed sales manager for Edwin Cooper.

DONALD A. BENNETT has been appointed managing director of The International Synthetic Rubber Co.

R. E. F. De TRAFFORD, OBE, chairman of Manchester Oil Refinery (Holdings), has been made a director of Lobitos Oilfields following the acquisition of MOR by Lobitos, and **E. G. C. MARDALL,** director and general manager of Lobitos, has been made a director of MOR (Holdings).

S. H. OLIVER, assistant manager of Castrol Ltd.'s purchasing department, has been made manager in succession to the late A. J. Stafford.

New Publications

"Topanol AN"—A booklet available from Imperial Chemical Industries Ltd. describing the properties, applications and methods of adding this antioxidant, developed by ICI's heavy organic chemicals division for converting certain highly unstable liquid hydrocarbon fractions into stable and marketable gasoline.

"From Nile to Indus: Economics and Security in the Middle East"—The Conservative Political Center, acting on behalf of the Conservative Commonwealth Council, does high public service by the publication of this 72-page brochure giving what is rightly termed "a clear and concise presentation of a problem vital to the whole world, and particularly to the countries of the Commonwealth and Western Europe." It deserves study not only by oil men but by everyone associated with or interested in Middle East affairs.

This survey is presented in five parts: I—World oil supply and demand; II—Middle East oil; III—Soviet oil and pressures; IV—The political background; and V—A projection. The sound and realistic manner in which world oil supply and demand are presented, as well as the role of Middle East oil and the complicated and widely varying political background, is warmly to be welcomed. Such minor errors of fact as there are in no way weaken the general theme.

Of particular importance is Part III and its conclusions as to how far the paramount menace of Russia is bound up with a specific Russian need for the use of Middle East oil for her own purposes. In summary, the authors conclude that it is the need for control of more sources of energy than the Communist world is likely to command that will incline the Kremlin to look more and more jealously towards the Persian Gulf. They believe its immense resources will persuade Russia more and more to realize a southward expansion. To believe anything else, they assert, is regarded as dangerous.

This publication is available, price 2s, 6d. net, from the Conservative Political Center, 32 Smith Square, London, SW1.

"Statistical Review of the World Oil Industry 1959"—British Petroleum Co. does the oil industry and economist the world over the highest service by speedily publishing so extensive a collection of data which can be accepted as the most reliable available. In its nine sections country and area statistics for 1959 are given (in many cases with 1958 for comparison) in both long tons and barrels (or b/d)—the latter a most useful innovation—covering (a) reserves, (b) production, (c) consumption, (d) supply and demand, (e) refining, (f) tankers, (g) energy, (h) an historical section, the salient industry statistics for 1938 and 1949 through 1959, with average rates of change, and (i) conversion factors (a section which could be expanded with advantage). Various charts and graphs are included. Copies are available from the company's Information Department, Britannic House, Finsbury Circus, London, E.C.2.

"Classified List of Equipment and Services"—The Council of British Manufacturers of Petroleum Equipment issues this as revised to December 1959, together with an addendum of new members to June 1960 and the items they offer. UK member-firms at the latter date numbered 600 and equipment and services are classified under 2,175 headings. Copies from CBMPE, 2 Princes Row, London, S.W.1, price 10s. post free.

Choice and Use of Fuel Oils—Mobil Oil Co. publishes 3 booklets: "The use and Storage of Fuel Oils." "Steam and Hot Water Boiling Testing" and "Fuel Oil Analysis." Together they form a well-presented and instructive digest of the factors which should be understood and applied in (a) making the preliminary survey for the correct choice of equipment for a new installation or a conversion, (b) achieving effective use of fuel oil in the various types of heating appliances, and (c) understanding the significance of fuel oil characteristics. Copies from the company at Caxton House, Caxton Street, London, S.W.1.

Russia Seeks More UK Oil Trade

The Soviet delegation is understood to have made special efforts to secure a higher share of UK oil imports in the first annual review of the 1959 five-year Anglo-Soviet trade agreement which took place in London in June. The government position, however, is reported to be that the state does not trade in oil and the companies have assured supplies from sources to which they have committments. The Board of Trade grants licenses to importers who need Russian oil for special manufacturing purposes or who can forward a special case. Soviet oil imports in 1959 were valued at just over £1 million, and at nearly £600,000 in the first four months of this year as compared with £266,000 in the same period of last year.

Polystyrene Plant for Russia

P. G. Engineering Ltd., member of the Power Gas group, has secured a contract from V/O Techashimport, Moscow, for the complete supply of a plant for the production of polystyrene with 5,000 tons/yr rated capacity. Process design will be supplied by BX Plastics Ltd., of Maningtree (Essex), which has recently installed a new unit of this type.

D.G.M.K. Meets in Frankfurt

A large program of technical papers has been planned for the 13th meeting of the German Association for Petroleum Science and Coal Chemistry (D.G.M.K.) in Frankfurt, October 17 to 19.

Speakers from both industry and research institutes have been scheduled for a number of simultaneous sessions, beginning Monday, Oct. 17. A total of some 45 formal presentations are indicated on the preliminary program, covering such subjects as analysis, instrumentation, processing of various types, geology, geophysics, fuel products, etc. In addition to German speakers, there will be petroleum scientists from United Kingdom and the USA on the program.

Forms Chemical Subsidiary

Sunray Chemical Co., a chemical and petrochemical manufacturing, sales and research subsidiary, is being organized by Sunray Mid-Continent Oil Co.

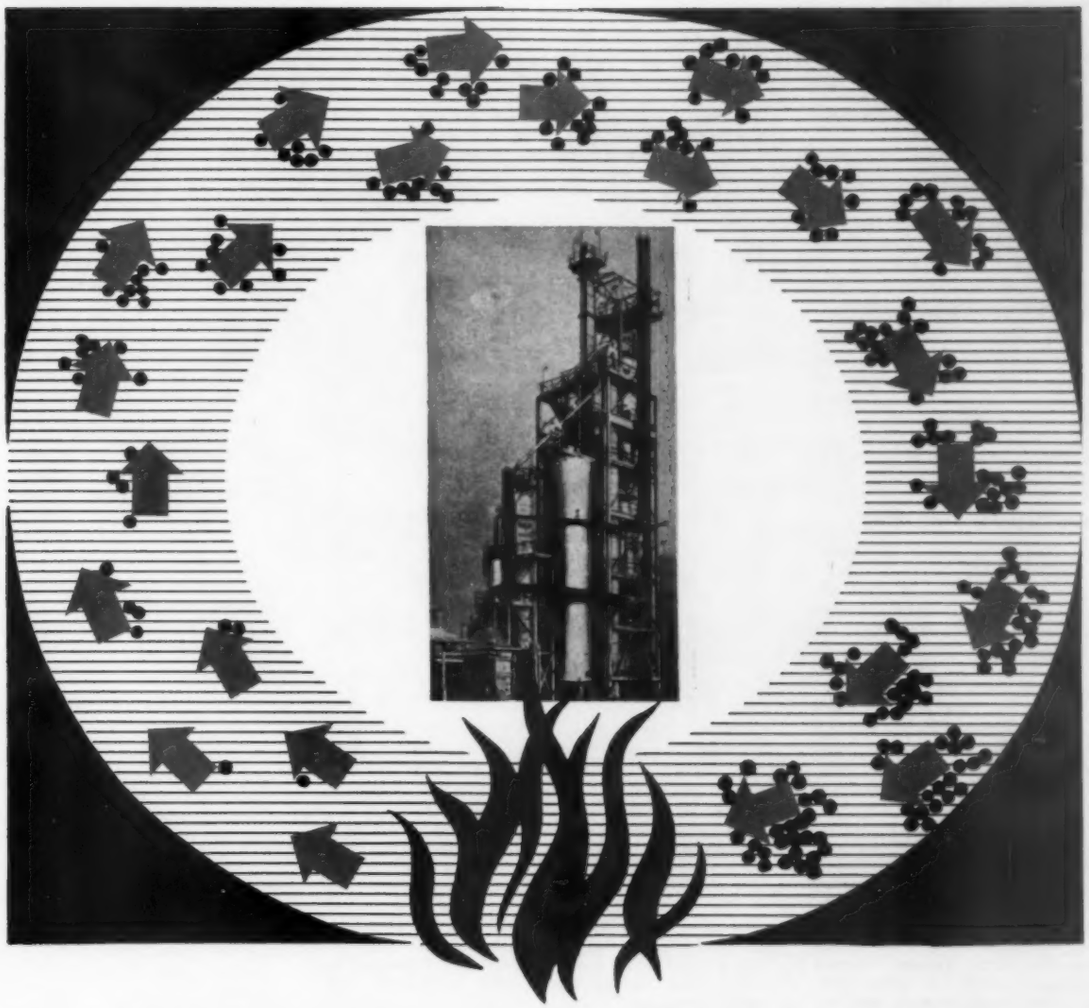
Glenn E. Wynn will resign as president of Suntide Refining Co., another subsidiary, to become president of the new firm, S. D. Breitweiser, who remains president of DX Sunray Oil Co., has been named president of Suntide as well.

USA Leads Refining Ownership

Petroleum Information Bureau of London, in a study of world refinery ownership, said USA companies own more than 57% of refining resources, a total of 665 million ton/yr, of which 460 million ton/yr is located in the USA. British and associated Dutch oil interests, after adding 22.5 million ton/yr to their plants in 1959, now hold better than one-seventh of the total world capacity. The communist bloc controlled 147 million ton/yr, of which 125 million was in Russia.

Correction

In the article on UK developments, issue of July 15, 1960, page 60, second column, 11th line, the sentence " . . . refinery output of products, excluding imported and indigenous crude . . . " should have read " . . . refinery output of products, ex imported and indigenous crude . . . "



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CANADIAN NOTES

Medium-Gravity's Day

Medium-gravity crude oil is having a big production rise in Saskatchewan.

Ontario refineries have modified equipment to run a larger proportion, and deliveries in recent months have been up 40% over 1959 comparative months.

Refiners To Run Less

Refiners have revised their estimates of crude runs for 1960—now expect an average of only 413,201 b/d domestic and 361,944 b/d of imported. Domestic runs will be down ½% from 1959; imported up 13%. The total of 775,195 b/d will be up nearly 6%.

Completions Up

July brought a marked upturn in western Canadian well drilling—with 240 completions—up eight from July 1959 and the first month to show an increase since February. Cumulative seven months' completions of 1,415 wells were down only 3½% from last year's 1,467 wells. Expectation for increases in the next three months raises hope for a total at least up to 2,500—same as in 1959.

West Canada Reports First Half

Drilling in western Canada (provinces of Alberta, British Columbia, Manitoba, and Northwest Territories) during the first seven months of 1960 was running ahead of the 1959 rate. Number of wells drilled was 67 less compared with the same 1959 period, but total footage was 7,573,129, up from 7,256,167. Alberta drilled a total of 930 wells, compared with 870 in the first seven months of 1959—of which 524 were oil, 138 gas. New strikes included 19 oil and 25 gas wells. Total footage for the province amounted to 5.7 million, about a million feet more than during the same 1959 months. Canadian Assn. of Oilwell Drilling Contractors reports B.C. recorded 98 holes drilled—including 38 oil and 16 gas—during the first seven months of 1960. New discoveries included four oil and 11 gas wells. During the same seven-month period, Manitoba drilled 38 wells—15 more than during the comparable 1959 period. While the number of wells drilled in the Northwest Territories during the first seven months this year rose to 13 from four in 1959, only one was a producer; all others dry. From January through July 1960, Saskatchewan drilled 316 wells, compared with 510 in 1959. Saskatchewan's total included four new discoveries.

B.C.'s Crude Output Steady

Total crude output for the first six months of 1960 in British Columbia of 405,190 bbl was slightly under the 405,704 bbl for June 1959. Total gas production in the province during the six months was 7.9 billion cubic ft higher than for the same 1959 period. During the first six months the province produced 43.1 billion cubic ft, compared with 35.2 billion in the same 1959 period.

B.C.'s Oil Pipeline Outlet

Trans Prairie Pipelines Ltd., Edmonton, will build British Columbia's first oil pipeline outlet for the province. The $5 million 130-mile line is scheduled for completion within 12 months. It will run from the Milligan Creek-Boundary Lake Oil fields, 100 miles north of Fort St. John, to Dawson Creek via Taylor Flats.

Gas Marketing Potential

If US Federal Power Commission issues permit for export of 204 million cubic ft per day of natural gas at Niagara Falls from Trans-Canada Pipe Line, Canadian exports by winter of 1961-62 could reach 1,400 mmcf per day, more than four times export volume in winter of 1959-60.

Preliminary To Gas Export

Estimate that 300 new gas wells will have to be drilled in Alberta to ready fields for new export project was made by Alex Bailey, president of The Alberta Gas Trunk Line Co. Ltd. after California Public Utilities Commission granted permit. Trunk Line will gather and deliver all gas for export market.

Bids For Large Gas Tract

Shell Oil Co. of Canada Ltd. made a successful bid of $3,087,095 for a 32,320-acre tract of potential gas land in the Alberta foothills at a mineral rights sale in Edmonton, said to be the highest price ever paid for a natural-gas license in the province of Alberta. It covers land from just west of the Wildcat Hills Mississippian gas field through Benjamin Creek gas area to the Panther River sulfur-gas region. Average price was $92.52 per acre. Three other land parcels located in southern Alberta did not receive offers.

To Extend B.C. Gas System

Gas Trunk Line of British Columbia Ltd. has announced construction will begin early in September on the first phase of a $93 million natural-gas pipeline system in northeastern British Columbia. To be completed in 1961, the line will deliver gas from the new Fort Nelson fields to southern B.C. and the USA. The 30-in. trunk line will extend 245 miles southward from Fort Nelson to connect with the existing Westcoast Transmission line near Chetwynd, B. C.

Suspends In Maritimes

After recent abandonment at 7,942 ft, without oil shows, of its Dorchester No. 1 well in New Brunswick, Imperial Oil Ltd. has suspended its oil search in the Maritime Provinces pending a re-evaluation of its prospects. Only exploratory drilling in the three provinces now under way is by Mobil Oil of Canada, which has a marine seismic program on its 600,000 licensed acres.

Pacific Pet. Buys Phillips, Sunray

Pacific Petroleum Ltd. has announced Phillips Petroleum Co. and Sunray Oil Co. have agreed upon an exchange of all their oil and gas properties and other holdings in Canada for common shares of Pacific Petroleums Ltd. Frank McMahon, chairman, stated, "following the consolidation a conservative valuation of Pacific's assets, including its Venezuelan properties and other holdings, will exceed $315,000,000."

The exchange will be on the basis of a mutual evaluation which has been made of the Canadian properties of the three companies and will bring Pacific's total share issue to 14,775,773 shares. Pacific's stock will be owned 39% by Phillips and 5.8% by Sunray.

Natural-Gas Sales Up

The first impact from increased natural-gas sales was responsible for increasing gross income of Home Oil Co. Ltd., Calgary, by 13% for the first half of 1960, according to a special report to the shareholders. The report forecasts an even larger increase for the second half of the year as the full benefit is felt from Carstairs gas and condensate production. Gross income for the first six months was up $538,000 to $4,515,873.

Mr. R. A. Brown, Jr., president, reported that the company's oil production was down slightly for the first half—from a daily average of 7,518 last year to 7,439. The drop was attributed to reduced production from the Harmattan field because of high gas oil ratio penalties. He said remedial action was planned which would reinject the gas now being flared into the oil formation. During the first half of 1960, the company produced 4,787,056,000 cubic feet of natural gas and 87,148 bbl of natural-gas liquids, compared with 3,217,448,000 cubic feet and 26,230 barrels for the first half of 1959.

More BP Outlets In Canada

British Petroleum now has 700 retail outlets in Canada. The latest extension to the network is in northern Quebec where BP Canada Ltd. has recently signed a marketing agreement with a local distributor centered on Maniwaki about 70 miles north of Ottawa. Products are being supplied by BP's new 1 million ton/year refinery at Ville d'Anjou near Montreal.

Gallup Firm In Engineering

Gallup, Buckland and Farney Ltd., consulting geologists of Calgary, Alberta, have announced the addition of an engineering department to their organization. This department is specializing in reservoir problems and is equipped to take on any type of petroleum engineering assignments.

The new department is set up under the direction of Mr. Maurice M. Holgate, who has 12 years experience in all phases of petroleum engineering. He has worked both in Iran and Canada.

Gas-Export Expenditures

Following approval of Canadian gas-export projects by US Federal Power Commission, operators are looking for completion of a main line to California by the end of 1961 in spite of delay at the start. Total related capital expenditure in Alberta is about $350 million.

Possible Gas Proration

Approval of export projects may precipitate Alberta Conservation Board decision on prorationing of gas production. Related LPGas production will be a problem. British-American Oil Co. has raised issue by asking permission to build pipelines connecting two major wet-gas fields with B-A's own Alberta refineries. Board may have to decide between "free enterprise" system, or province-wide pipeline grid which might involve prorated production as only feasible method of handling.

Ontario Hydrodesulfurizer

Cities Service Refining Co. will start immediately on a $1 million hydrodesulfurizing unit at Trafalgar, Ontario, refinery. The unit is to be completed early in 1961. It will increase flexibility of operations; may be tied in with possibility of using more Saskatchewan medium-gravity crude which is in surplus supply.

Alberta Production Down

Alberta crude production was set below minimum economic allowable for August, at 307,904 b/d for light- and medium-gravity. For the first time, all fields and wells were scaled down 5% below theoretical breakeven point. September estimate was for only 300,463 b/d—with October to continue below economic level, at 323,332 b/d.

May Delay Montreal Line

Big gas-export pipelines and processing-plant construction may defer agitation about Montreal oil pipeline. Large capital commitments will take up all resources of producers at present, as heavy borrowing will be required.

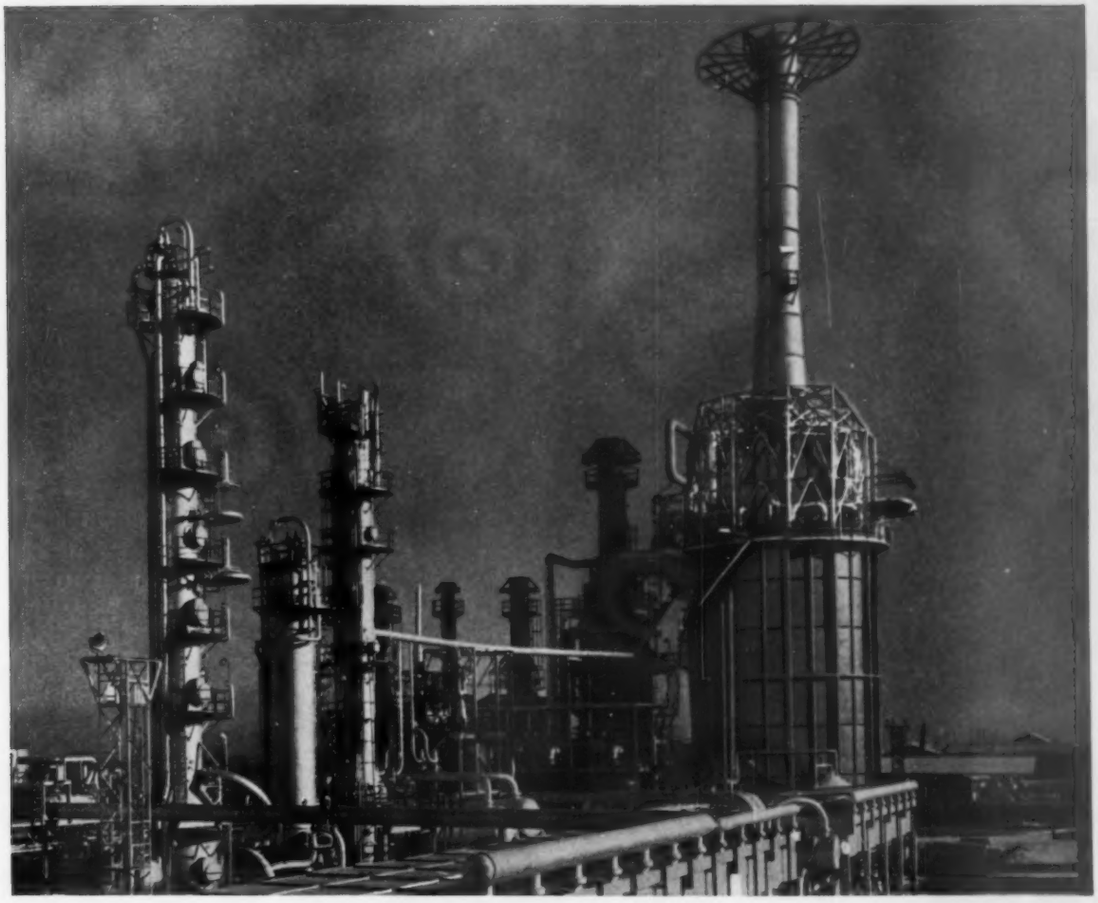
NEW PUBLICATIONS

The 1959 edition of the annual *Petroleum Sourcebook* has just been published by National Petroleum Bibliography, Box 3586, Amarillo, Texas.

A worldwide directory of information sources classified by country, region, and state or province, the 234-page book is priced at $7.50 per copy and may be ordered direct from the publisher, on approval if desired.

Runnerless Molding, by Ernest P. Moslo. A survey of the theory, design, applications and economics of runnerless molding. Primarily directed to the plastics and related industries, the book demonstrates the ways in which runnerless molding may be employed to eliminate sprue scraps, cut labor costs, minimize rejects and greatly speed production. Published by Reinhold Pub. Co., 430 Park Ave., N. Y. 22, N. Y.

"Elements of Petroleum Reservoirs," is a new book for investors, managers, supervisors and engineers written by Norman J. Clark and published by the Society of Petroleum Engineers of AIME, 6300 North Central Expressway, Dallas, at $7.00. Featuring 174 illustrations, Clark has written the book for the non-reservoir engineer who seeks a basic understanding of petroleum reservoirs. The material is presented in narrative style which is free of mathematics and physical formulas.



176 million Btu/hr from a single vertical heater

The Foster Wheeler direct-fired heater above is the largest cylindrical vertical heater in the world. It was designed and built for the Powerformer section of a major French refinery.

This unusual unit features a 41-foot diameter fire box and a separate horizontal convection section. It has an overall height of 200 feet and is designed for high thermal efficiency with ease of operation. Foster Wheeler coordinated U. S. engineering and foreign procurement to assure minimum cost.

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—Leo D. Welch, Chairman of the Board

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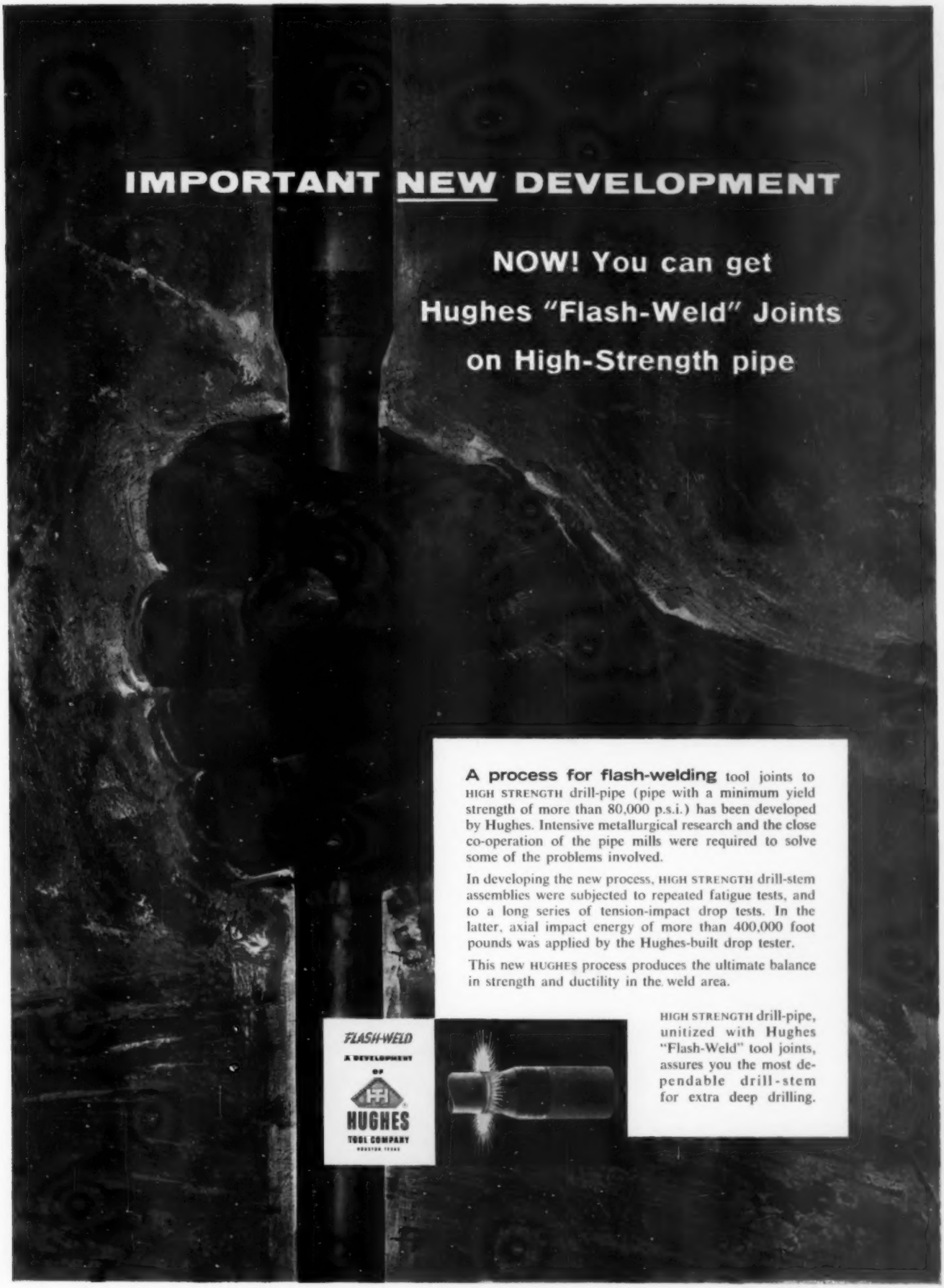
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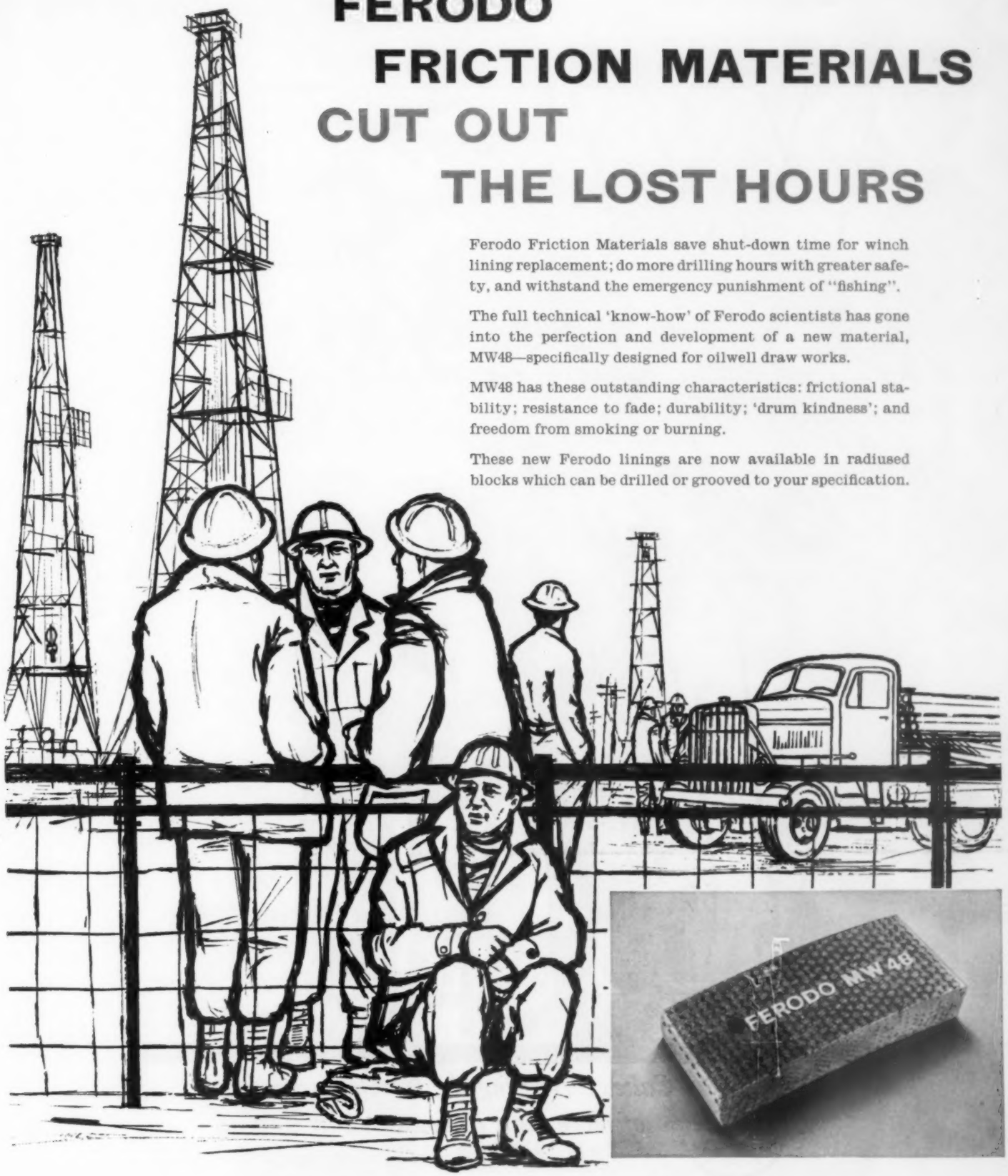

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WHERE RESEARCH TODAY MEANS PROGRESS TOMORROW

October is Gasoline Tax Reminder Month!

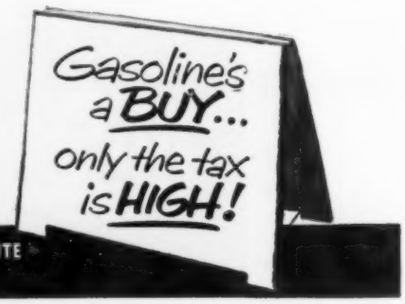
It's the anniversary of the latest temporary Federal gasoline tax increase!

Every oil man and woman should be keenly aware that October is gasoline tax reminder month. October 1, 1959, was the day the temporary 1¢ increase in the Federal gasoline tax went into effect, making the total Federal tax 4¢ a gallon. That's why October is an excellent time for you to remind your friends and business associates about high gasoline taxes. And make sure they know that Congress promised this temporary tax increase would expire on June 30th, 1961 . . . and the Federal tax revert to 3¢ a gallon.

Here are the facts about high gasoline taxes that everyone should know:

- **Motorists pay about one dollar in taxes on every ten gallons of gasoline they buy!**
- **The gasoline tax rate is five times as high as the tax on luxuries like diamonds and mink coats!**
- **Motorists now pay about a 50% sales tax on gasoline!**

So, take advantage of this special gasoline tax reminder month and give your friends the facts about high gasoline taxes.



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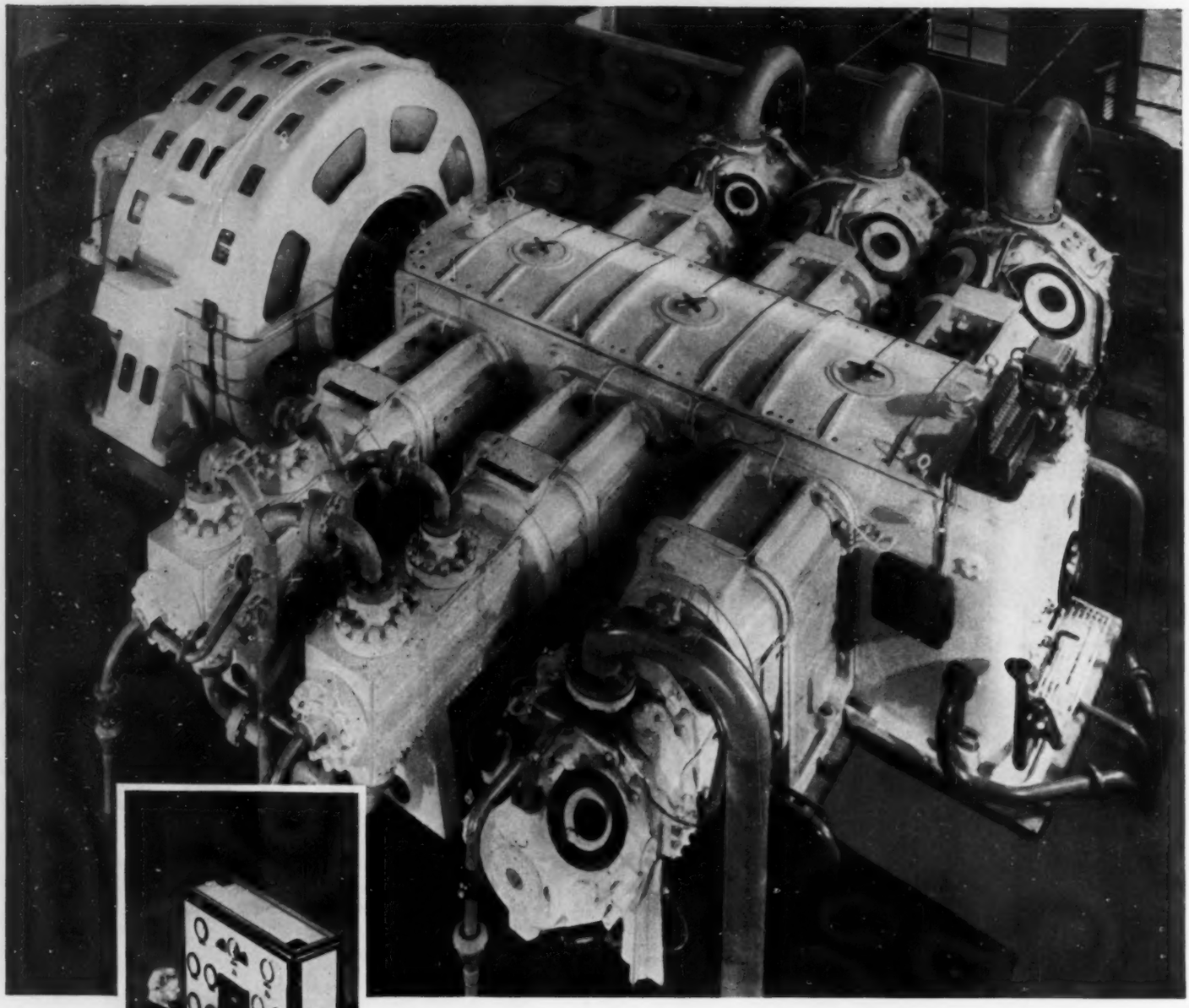

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One of a number of Brotherhood six crank five stage compresssors supplied to The British Oxygen Company Ltd. Each compressor has a capacity of 8,670 m³/hour, delivery pressure 185 atmospheres, driven by 3,050 H.P. synchronous motor.

Brotherhood compressors are designed to customers' exact requirements.

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To make this possible, the search for oil must never stop. Formed in pre-historic times, crude oil is found deep in the earth's crust. Locating it demands all the skills modern science can command. And Standard-Vacuum is ready—with the personnel, the equipment and the experience needed to carry on this vital work.

But exploration is only one part of Stanvac operations. Throughout Asia, Africa and the lands of the Pacific, Stanvac drills for oil, then refines and markets it in many forms. In this way, Stanvac helps the people in these areas to help themselves toward a better life.

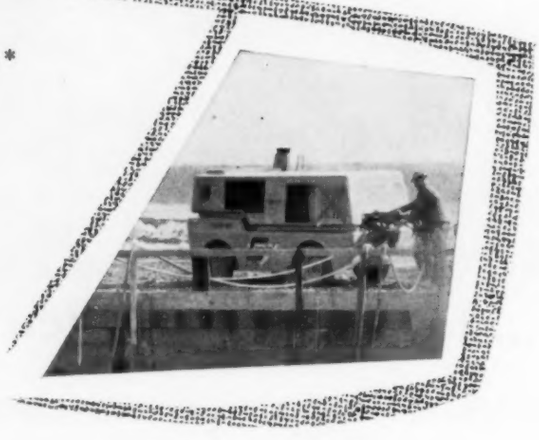
STANDARD-VACUUM OIL COMPANY **POWERS PROGRESS**

White Plains, New York

The latest addition to the Rotair range *

of rotary screw compressors

The Rotair 370



This Holman Rotair portable rotary screw compressor has an output of up to 370 cubic feet a minute at 100 p.s.i. *in one stage*, with a temperature rise only 100°F above ambient. No timing gear is employed in the Rotair 370, ensuring additional reliability . . . with all these advantages too . . .

Pulseless output.
Negligible compressor maintenance.
Minimum friction.
Light weight.
Only two moving parts and four bearings.
* Rotair portable rotary screw compressors are available with outputs of up to 600 c.f.m.

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with new Johnston tool!

"The Johnston Selective Zone Tester saved us five days rig time!"

Mr. Ernie Walker,
Drilling Superintendent,
Calvert Drilling Co.

The Jordon #1 was drilled by Calvert Drilling Company in Dewey County, Oklahoma and bottomed at 11,000 feet.

Drilling the well accomplished only part of the job. Now it became necessary to evaluate all possible producing zones and complete this well if it proved commercially productive. Just as during drilling operations, any delay in evaluation is costly. An idle rig, inoperative tools, equipment breakdown, needless action—all mean lost dollars.

The job of determining subsurface formation conditions was given Johnston Testers. **A total of nine Selective Zone Tests were run:**

Test interval—9534 to 9550 feet. Dual packers top and bottom. Used Johnston Selective Zone Anchor. Good test! Released tool, picked up 8 feet to interval 9526 to 9542 feet. Re-set tool. Another good test!

Test interval—9564 to 9685 feet. Dual packers top and bottom. Used Johnston Selective Zone Anchor. Formation failed to support mud weight. **Picked up tool and re-set seven times at different intervals.** Anchor worked perfectly, did not slide at any time!

The ability to set, release and re-set the Selective Zone Anchor allowed testing of many zones with just one trip in the hole. Extra time was saved since long tailpipe did not have to be run.

Selective Zone Testing with the new "CO" Combination Shut-In Hydraulic Tester and the new Selective Zone Anchor can save you money, too! Write Johnston Testers and learn why you get more from a Johnston Test!

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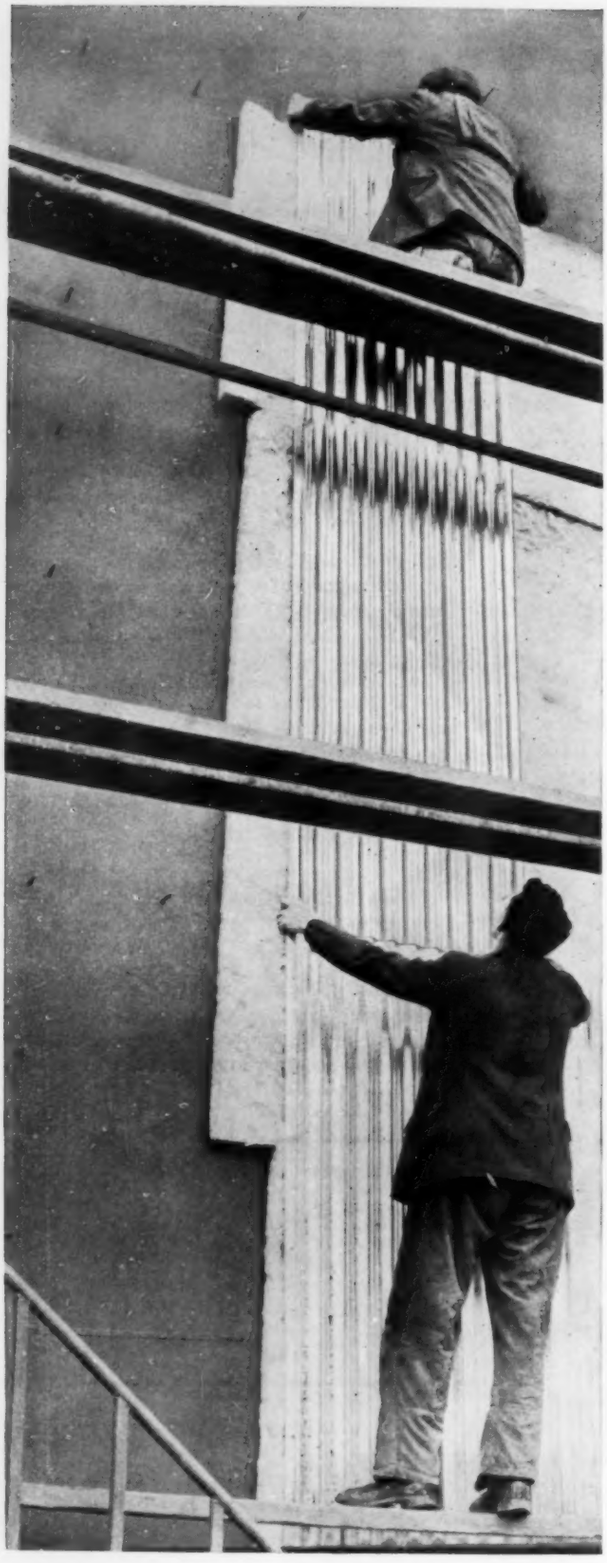

Esso adopt Fibreglass Crown with Stud Welding Technique

This tank at Esso's Tynemouth terminal is getting the latest in insulation treatment—Fibreglass Crown with Stud Welding Technique. This has been devised jointly by Crompton Parkinson (Stud Welding) Limited, makers of 'Setlok' Studs and Fibreglass Limited, makers of Crown insulation.

Fibreglass Crown with the Stud Welding Technique has four main advantages over the methods it replaces. It costs considerably less; it is quicker; it is easier to apply; and it provides better insulation.

Fibreglass Crown with its special attributes—not the least important its exceptional tear strength—is particularly suitable for this method of insulation.

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At McCullough you'll find bullet and jet guns, in a variety of types and sizes, to handle every requirement—quickly, efficiently and profitably—your *best* bet for *best* production!

FOR PERFORATING IN CASING

McCULLOUGH BULLET GUNS—World's hardest shooting bullet guns. Best available perforating process in all formations except extra hard.

McCULLOUGH GLASS JET GUNS—Most versatile and efficient of all jet casing perforators. Deep penetrating, carrot-free, junk-free. Uses flexible, retrievable Steel Strip Carrier. Gets best results in hard formation.

McCULLOUGH TUBULAR CASING JET GUNS—Star Jet, DuPont, Dynajet and Super Dynajet charges are available in most areas to meet varying well conditions.

TORPEDO JET GUNS, expendable type perforators for cased and open hole operations. Offered in limited areas.

FOR THRU-TUBING AND SLIM-HOLE PERFORATING

McCULLOUGH SECTIONAL BULLET GUNS—Only small diameter bullet guns made. Sizes are 1⅛", 1⅜" and 2⅛" OD. Backed by a record of more than 20 years of fine performance.

McCULLOUGH MAC-JET GUNS—Finest and most advanced of all small diameter, expendable jet guns. Features include enclosed firing system, minimum debris, deep penetration, high well flow index, carrot-free. Widely used in both thru-tubing and slim hole work.

OTHER SMALL DIAMETER GUNS include the **LINK JET** and **TORNADO JET,** expendable thru-tubing perforators; and the **SIDEWINDER,** a retrievable jet perforator for slim hole operations.

SPECIAL APPLICATIONS

McCULLOUGH FOUR-WAY SQUEEZE JET GUNS—designed to assure even distribution of cement around casing. **FRAC-JET**—fires eight jets on a horizontal plane for fracture placement.

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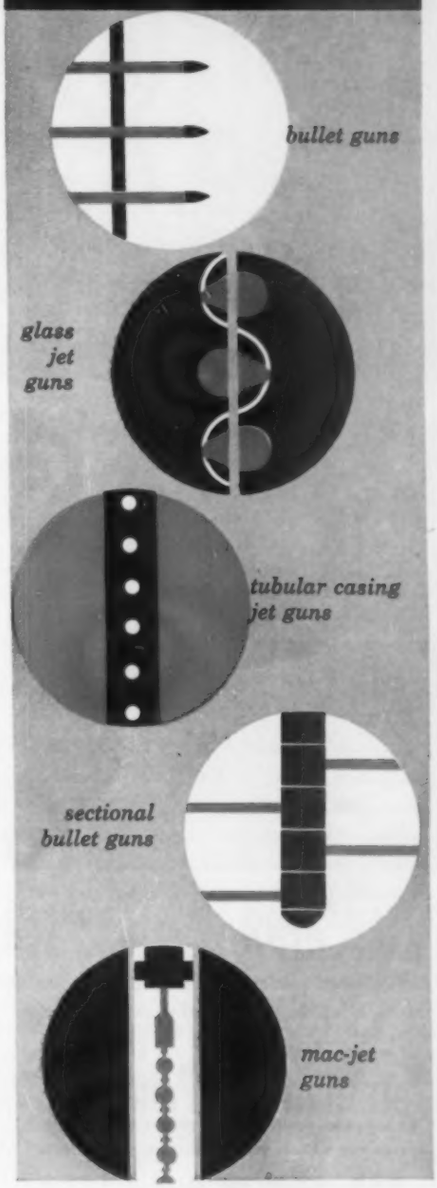

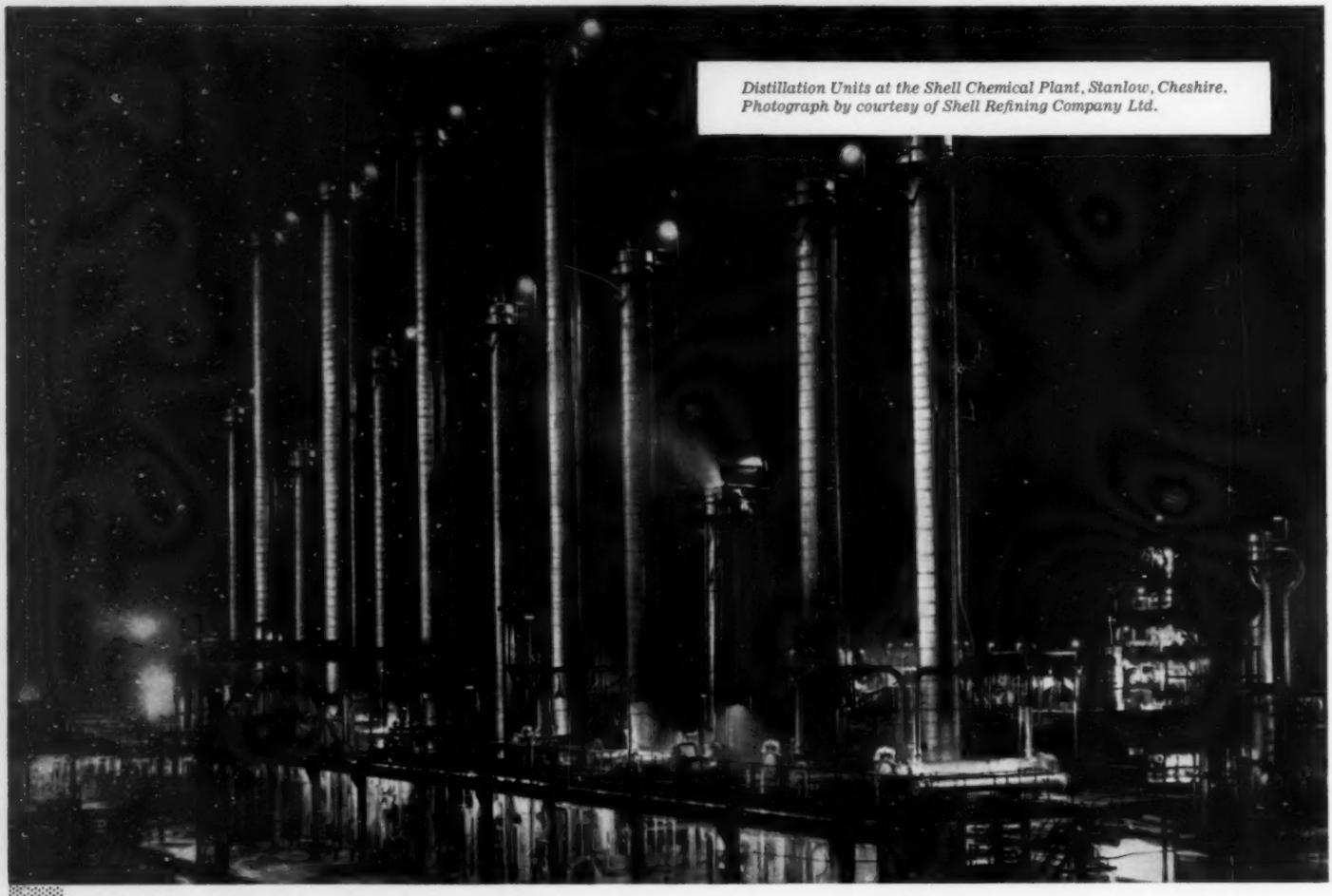

Distillation Units at the Shell Chemical Plant, Stanlow, Cheshire. Photograph by courtesy of Shell Refining Company Ltd.

International Paints

for the oil and petro-chemical industries

Bright as a constellation, this Shell Distillation Plant shines out over a darkened landscape. Representing so much in capital outlay it must be protected against the sharp teeth of corrosion, and what better for the purpose than Episeal Aluminium Paint. Episeal, one of the comprehensive range of International paints for the oil industry is an air-drying Epoxide paint. Tough as nails, long-lasting, resistant to dirt and corrosion, it gives ideal protection to storage tanks, rail tank cars, pipelines and other structural steelwork. Specify Episeal Aluminium Paint—and remember that the best results can only be obtained by using a full International painting scheme.

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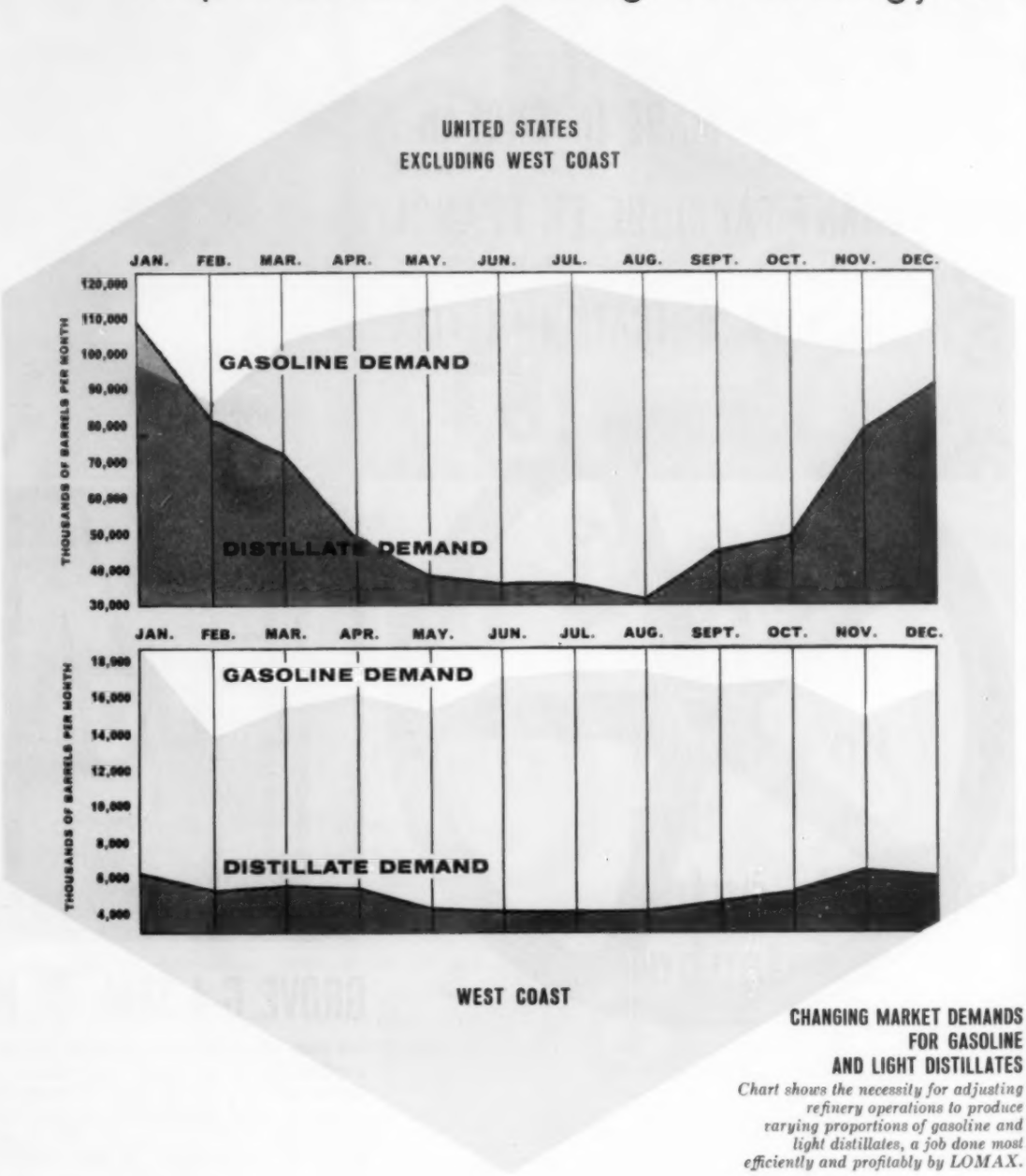

CHANGING MARKET DEMANDS FOR GASOLINE AND LIGHT DISTILLATES

Chart shows the necessity for adjusting refinery operations to produce varying proportions of gasoline and light distillates, a job done most efficiently and profitably by LOMAX.

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Here is a new and vastly important process to which every refiner should give serious consideration—now! Regardless of present markets and whether existing facilities are old or up-to-the-minute, LOMAX may prove economically attractive through *increased year-'round production of your most saleable products.*

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- **LOMAX** produces **maximum saleable product**...up to 120 barrels of product from 100 barrels of charge stock.

- **LOMAX** gives you **maximum production** of the product you want when you want it...whether gasoline or light distillates.

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Nominal Size (inches)	O.D. (inches)	Wall Thickness (inches)	Wt/100 ft (pounds)	Standard Lengths (feet)	Approximate Bursting pressure (lbs/sq inch)
1¼	1.660	.065	38.3	20 – 30 – 40	2430
1½	1.900	.065	44.1	20 – 30 – 40	2110
2	2.375	.065	55.5	20 – 30 – 40	1680
2½	2.875	.083	85.6	20 – 30 – 40	1770
3	3.500	.083	104.8	20 – 30 – 40	1450
4	4.500	.083	135.4	20 – 30 – 40	1120
5	5.563	.109	219.6	20 – 30 – 40	1190
6	6.625	.109	262.4	20 – 30 – 40	1000

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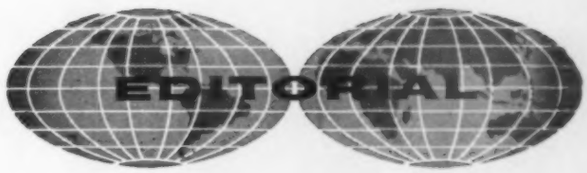
Everybody Wins!

The importance of over-all *safety* is rewarded at Halliburton each year by the presentation of this beautiful trophy to its winning division. Other individual and group awards keep *safety* in the minds of every Halliburton employee all year long. We believe that in practicing safety — everybody wins . . . our fellow workers, our customers, and fellow citizens. That's why we always held to our slogan:

"We'll get there somehow . . . . safely!"

Halliburton COMPANY

DUNCAN, OKLAHOMA



A SMALL WORLD

"The world is growing smaller." In the United Nations and from public platforms everywhere this statement is uttered daily and it is a demonstrable truth with an impact on both nations and individuals.

The petroleum industry has been an important contributor to the situation and, in one sense, is its victim. As a developer of aviation fuels the industry has helped bring eastern and western hemispheres within hours of each other. A substantial segment of the oil business is in aviation fuels and lubricants. In the movement of freight by sea, oil has contributed to faster turn-around in port and speedier vessels. Here again it has reaped a harvest in new business for the bunkering of freighters and passenger liners. Land transport has been affected similarly by the adoption of oil-powered diesel locomotives.

A side result of low-cost, speedier transportation of goods is the destruction of comfortable barriers against outside competition and the leveling of world markets for commodities. Except in areas where government steps in to protect the local business of its own citizens the price of commodities in general use tends to level out very quickly at a point dictated by the lowest cost source of supply. In this respect the petroleum industry is a victim of its own contribution to the modern world since low-price, or low-cost products in any part of the world will dictate markets half the world away.

The government of the United States has erected a dyke to protect domestic producers against lower cost petroleum produced in the Middle East and Latin America. While the dyke holds back a considerable volume of oil it does not protect domestic producers or refiners against all of the pressures of world prices. If there were no surplus oil in the Caribbean or on the Persian Gulf, producers in the USA would be selling their crude at a considerably higher price than they are today, certainly more in line with the higher costs which they are encountering for equipment and labor. As it is they must try to be content with thin profit margins until world conditions become more favorable.

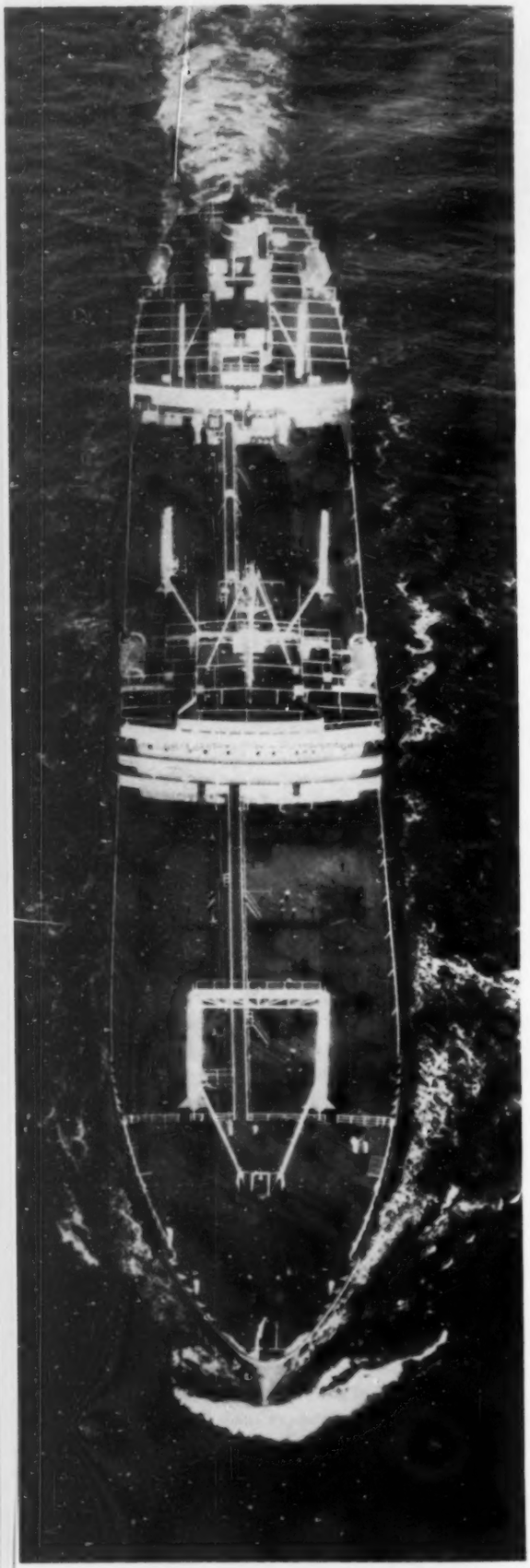
Another factor has tended to complicate world markets in recent months—competition of oil from the USSR. At least some of this new competition has been dictated by political considerations and not by pressure of surplus seeking a market. The offers of oil to Cuba and India are examples. There is no doubt that the USSR has the ability to produce and deliver more oil into world markets. Such are the conclusions of the group of USA oil observers who recently returned from a trip to view Russian fields and plants. It is to be doubted, however, whether Russian costs are low enough to permit profitable price cutting in competition with Venezuela and Kuwait. And it is an unfortunate fact that a low price on a small volume of oil exerts a disproportionate effect on world markets. Of course this is not confined to oil. A few distress tankers seeking cargoes can ruin the cargo market.

Government leaders in some of the nations which are blessed with large crude surpluses have indicated that they think it is to the advantage of the international oil companies to reduce crude prices. They observe that these companies have large refining and marketing operations in the big markets and jump to the conclusion that low crude costs will enable the producers to make more money.

The facts are that the situation is just the reverse. It is always to the advantage of integrated companies to have a strong crude market. Backed by such a market they are able to sell their refined products at a reasonable level. Whenever crude prices start to break there is an immediate reaction in wholesale and retail markets. There is no mystery about this. There are independent refiners and marketeers throughout the world who are eager for more business. When they can buy some low cost crude their salesmen go out into the field to drum up more business. The volume may be small but it does affect the whole market and does it quickly.

National economies which are based on producing revenues cannot escape the effect of the law of supply and demand. If they force producers to take more oil to keep income steady they contribute at once to further market demoralization. If they restrict output their revenues fall in proportion unless they can persuade everyone else to follow—a most difficult job. If they raise royalties or taxes in an effort to obtain a greater share of the sales dollar they tend to drive business into the hands of other countries.

We have a world surplus of oil and we must learn to live with it for a while until demand catches up with supply. This is not a time for mutual recriminations between producer nations and oil developers. Mutual understanding of the problems of both the oil companies and of the leaders of oil-based economies will help. The companies and the governments are partners and should realize it.



Striking air view of one of BP Tanker Co.'s 32,000-tonners, the "British Courage," during her sea trials in the North Sea.

World tanker fleet shows slower rise

Fewer new vessels on order. Liberia maintains lead as world's largest fleet. More than half of new ships scheduled for launching will be 40,000 dwt and over. Rates remain depressed.

THE WORLD TANKER FLEET is still expanding but the rate of growth is declining. The impetus that followed the Suez crisis is spent, as indicated by the latest analysis of tonnage available, that of Davies & Newman Ltd., London ship, oil and air brokers.

As of July 1, oil tankers (excluding whale oil factory ships) of 500 tons gross and over totalled 65,130,093 dwt, a net increase of 1,758,478 dwt (2.8%) since January 1. During the first six months this year, 83 new tankers of 7,000 dwt and over were launched, aggregating about 2,842,000 dwt. Fifty-two of these were 30,000 dwt and over, resulting in an average deadweight for all vessels of just over 34,200 tons. This net increase is the lowest since the first half of 1956 and the figure for vessels launched is the lowest for any six months since the same period of 1957.

At the same time, during the first half of this year, 67 tankers were scrapped, totalling about 838,000 dwt, a slight increase on the previous six months' record figure. In addition, 19 vessels totalling some 315,000 dwt were converted into dry-cargo vessels. Thus, this year to June 30, 86 vessels (including 23 T-2 tankers) totalling about 1,153,000 dwt had been scrapped or converted, as compared with 77 vessels of 994,000 dwt scrapped or converted during the last half of 1959.

The most interesting feature of the detailed analysis by flags shown in Table 1 is the decrease of about 560,000 dwt under Liberian flag to just over 12.0 million dwt. This is due to the transfer of many vessels to Greek flag, and the registration of new-buildings under Greek flag this year which have been expected to fly the Liberian. As a result, tonnage under Greek flag has shown a half-year's increase of 831,719 dwt, and at 1.5 million dwt is more than double the January 1, 1960, figure.

A number of reasons are seen for this, including the success of the new Greek shipping laws and the attractiveness of the tax concessions; the obstacles placed in the way of PanHonLib ships by unions in various parts of the world; and the fact that during the current shipping depression the tax-free advantages offered by the "flag of convenience" countries are minimal.

While the Liberian tanker fleet remains the world's largest, its superiority is seen to be narrowing. Whereas on January 1, Liberian tonnage was 19.0% above the British, the second largest; by July 1 this superiority had dropped to 9.9%. The net rise in the British total over the half year was 373,648 dwt (3.5%); that of USA flag vessels was far more modest at 25,206 dwt (0.4%).

Trends in the registry of tankers, based on 2,000-ton gross weight vessels, and in terms of T-2 equivalents, are shown in Table 2.

Davies & Newman reports that, in terms of deadweight, pre-war tonnage (500 tons

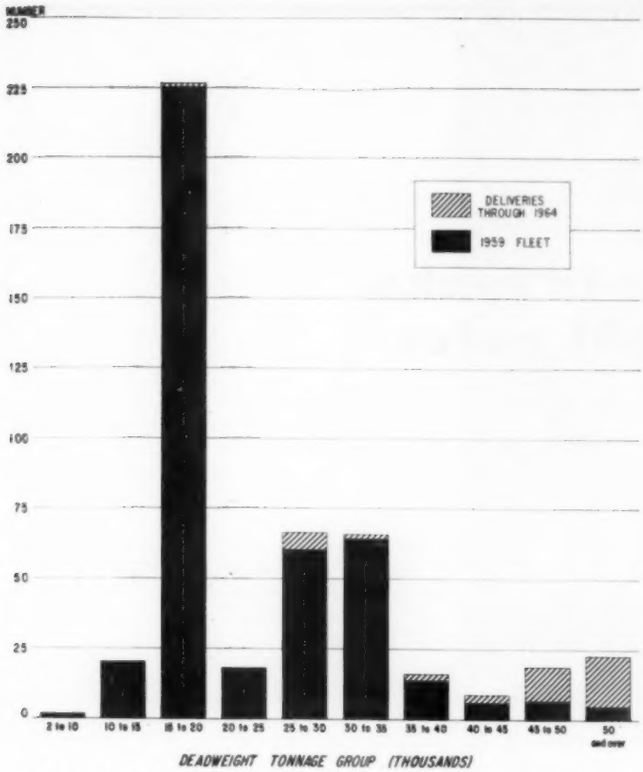


Fig. 1—Privately-owned USA flag vessels, as of Dec. 31, 1959, and scheduled deliveries through 1964, in T-2 equivalents. Source: Sun Oil Co.

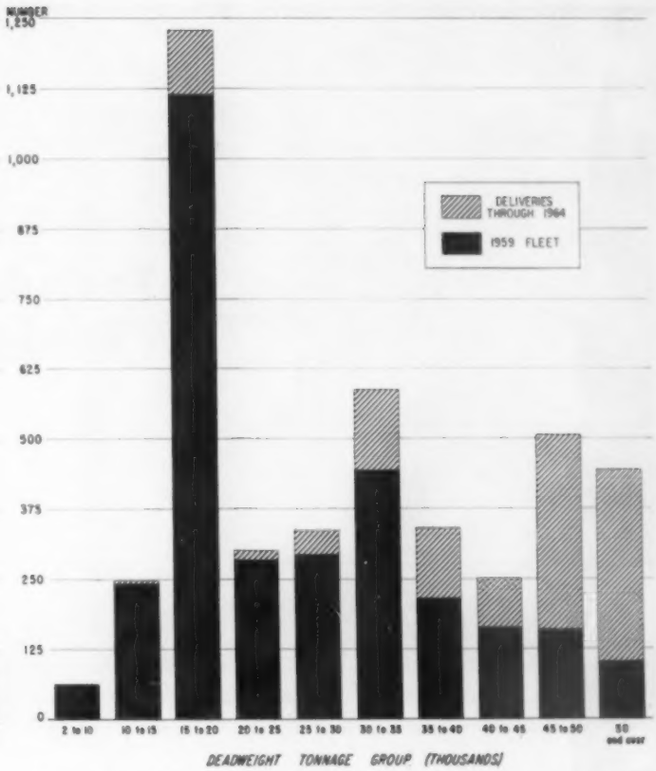


Fig. 2—Privately-owned non-USA flag vessels as of Dec. 31, 1959, and scheduled deliveries through 1964, in T-2 equivalents. Source: Sun Oil Co.

TABLE 1—World Tanker Tonnage
(500 tons gross and over)

Country of Registration	July 1, 1960 1,000 dwt	Per Cent	Jan. 1, 1960 1,000 dwt
Liberia	12,007	18.4	12,567
United Kingdom	10,928	16.8	10,555
Norway	9,663	14.8	9,683
United States	6,906*	10.6	6,880*
Panama	3,868	5.9	3,920
France	2,992	4.6	2,867
Italy	2,778	4.3	2,546
Sweden	2,443	3.8	2,458
Japan	2,267	3.5	2,128
Netherlands	2,215	3.4	2,005
Greece	1,525	2.3	694
Denmark	1,381	2.1	1,339
Germany	1,069	1.6	977
Russia	1,034	1.6	965
Spain	641	1.0	613
Brazil	503	0.8	450
Argentina	452	0.7	450
Venezuela	407	0.6	405
Belgium	286	0.4	294
Finland	261	0.4	258
Portugal	186	0.3	147
Mexico	184	0.3	184
Turkey	124	0.2	105
Poland	105	0.2	94
Others	905	1.4	758
Total	65,130	100.0	63,372

*Commercial fleet only.

gross and over) now represents 4.9% of the world tanker fleet; war-built tonnage, 15.2%; tonnage built between 1946 and 1955 (inclusive), 35.4%; and tonnage built between 1956 and 1960 (inclusive), 14.5%. The position of the four largest fleets is shown in Table 3.

Newbuilding contracts fell during the first six months of this year by about 2,830,000 tons, to 16,302,950 tons. This figure excludes contracts known to be options, or where there is an option of building a dry-cargo vessel. Of the 398 vessels still to be launched, 320 will be of 24,000 dwt or greater, and 209 of these being in excess of 40,000 tons. Only 55 are to be in the "general purpose" class of 16/24,000 dwt (See Table 4). British yards on July 1 had 17.5% (2,851,000 dwt) of the contracts, Germany 16.7% (2,726,500 dwt), Japanese, 16.5% (2,699,200 dwt), and Swedish 14.3% (2,332,500 dwt). By contrast, newbuilding in the USA represented only 5.1% (826,000 dwt).

Laid-up tankers. Monthly details by countries of tanker tonnage laid up for lack of employment have been issued since last November by the Chamber of Shipping of the United Kingdom. Between January 1 and August 1, 1960, the world total has gone up 598,000 gross tons (18.8%); but whereas the British flag has contributed 172,000 gross tons to this total, an increase of 30.7% over the year, USA tankers had 37,000 tons (10.5%) less laid up. Monthly changes over this year are given in Table 5. The figures are compiled from information received at Lloyd's and exclude, inter alia, coasters

TABLE 2—Trends in the Registry of World Tanker Fleet
(Ocean-going vessels 2,000 gross tons and over)

Flag	Dec. 31, 1954 T-2 Equiv.	% of World	Dec. 31, 1958 T-2 Equiv.	% of World	Dec. 31, 1959 T-2 Equiv.	% of World	Percent Change from 1954	Percent Change from 1958
Liberia	204.1	9.1	700.1	20.6	794.3	20.8	289.2	13.5
USA	521.7	23.3	529.5	15.6	563.0	14.7	7.9	6.3
Norway	333.1	14.8	502.1	14.8	555.8	14.5	66.9	10.7
United Kingdom	397.9	17.7	493.2	14.5	555.6	14.5	39.6	12.7
Panama	194.3	8.7	232.4	6.8	244.8	6.4	26.0	5.3
France	89.5	4.0	150.0	4.4	169.9	4.4	89.8	13.3
Italy	98.7	4.4	133.3	3.9	143.3	3.8	45.2	7.5
Sweden	78.5	3.5	129.6	3.8	141.1	3.7	79.7	8.9
Japan	58.0	2.5	102.9	3.0	128.4	3.3	121.4	24.8
Netherlands	52.0	2.3	108.8	3.2	109.4	2.9	110.4	0.6
Other	216.2	9.7	321.4	9.4	419.5	11.0	93.8	30.5
Totals	2,244.0	100.0	3,403.3	100.0	3,826.1	100.0	70.5	12.4

TABLE 3—Leading Tanker Fleets by Age Groups
(% of total dwt, for vessels 500 gross tons and over)

Fleet	Pre-war	War-built	1946-55	1956-60
Liberian	2.3	8.9	29.7	59.1
Norwegian	3.8	3.8	51.4	41.0
British	3.2	13.6	42.7	40.5
USA	3.0	55.3	17.8	23.9

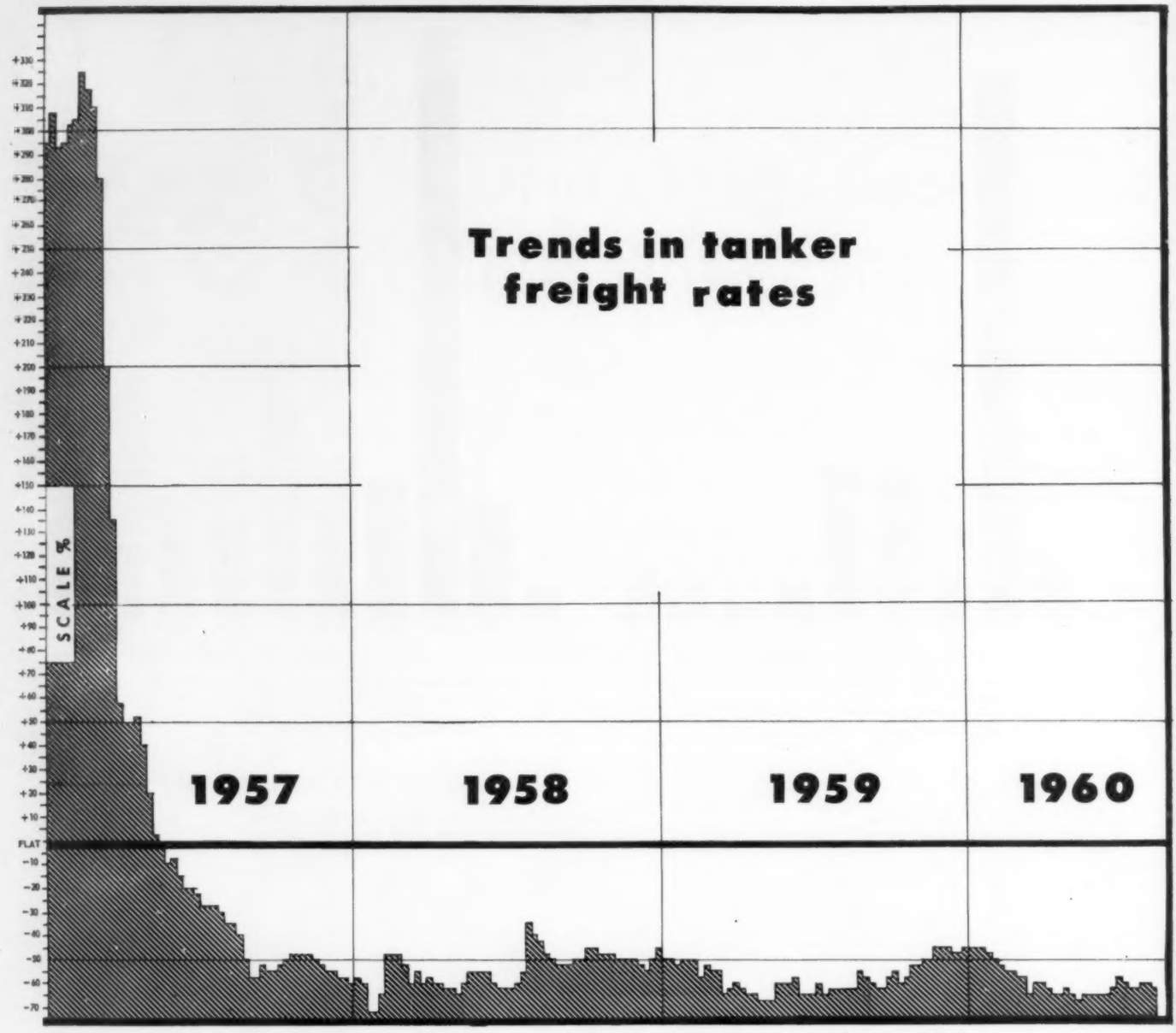


Fig. 3—World tanker freight rates have been bumping along the bottom for more than three years. Weekly indices calculated by Harley, Mullion & Co. Sterling values calculated from representative dirty fixtures.

and certain vessels normally engaged on short voyages.

Much interesting commentary of a general character on the state of the world tanker fleet is given in the half-yearly analysis by John I. Jacobs and Co., London.

Limiting its considerations to the more strictly ocean-going vessels, of 2,000 dwt and over, the world fleet is seen as having risen to 62,805,889 dwt on June 30 from 60,938,861 dwt on December 31, 1959—a rise of 1,867,028 dwt (3.1%). The distribution of this fleet is given in Table 6, and trends in Table 7.

Factors are discussed in the Jacobs' report which add considerably to the difficulties of producing reasonably reliable delivery forecasts. However, the following tonnages are believed reasonable (figures in parentheses are T-2 equivalents): 1960 second half—2,750,000 dwt (191); 1961—5,500,000 dwt (383); 1962—4,500,000 dwt (308); 1963—2,500,000 dwt (173); and 1964—1,000,000 dwt (70).

A further indication of growth trends in the world tanker fleet from December 31, 1959, through 1964 is given in Figs. 1 and 2, two charts presented in the 18th annual Sun Oil Co. "Analysis of World Tank Ship Fleet," the latest report having been released late in August. It should be emphasized that these charts show simply the 1959 data plus scheduled deliveries through 1964 for private fleets, but with no deletions for scrappage.

Two conclusions with respect to supply-demand are reached in the Sun Oil study, which was authored by Dr. James S. Cross, manager of Sun's statistical research dept.:

1. With respect to the USA flag private fleet: if known construction and orders at the end of 1959 are added to the existing fleet at that time with no allowance for deletions, carrying capacity would increase during the 1960-1964 period from 421.0 T-2 equivalents to 466.6 T-2's. During this same period, the requirements of the USA flag trade (based solely on domestic shipments) are projected to grow from 265 to 322 T-2's.

It was calculated that in order to bring supply to a level at which tanker charter rates might show an upward trend, all vessels which would be 21 years or older by the end of 1964 would have to be deleted.

2. With respect to the non-USA fleet of privately owned tankships: the addition of 1,217 T-2's scheduled for delivery by the end of 1964 to the 1959 year-end fleet would result in a carrying capacity of 4,311 T-2's.

TABLE 4—World Tanker Fleet Distribution by Tonnage (as of July 1, 1960)

Dwt.	Number of Ships — In service and launched	Number of Ships — Building and contracted
7,000- 9,999	113	6
10,000-12,999	346	9
13,000-15,999	291	8
16,000-18,999	996	11
19,000-23,999	403	44
24,000-39,999	652	111
40,000-79,999	178	200
80,000-plus	9	9
Totals	2,988	398

Estimates of the requirements for this fleet show an increase of 33.8%, to 3,169 T-2's by the end of the projection period. It was calculated that all flag ships 14 years or older by the end of 1964 would have to be removed in order to bring supply into reasonable balance with demand.

Tankers are continuing to grow in size. There is a constantly rising proportion in the group above 30,000 dwt. No less than 48 out of the 98 additions made in the half-year are in this category, including one of about 65,000 dwt, one of just over 50,000 dwt, and 10 in the 45,000/49,999 dwt range. Thus, although the world rise was 1,867,028 dwt, tankers of 24,000 dwt and over alone rose about 2,000,000 dwt; deliveries below this size being more than balanced by scrapping, etc.

Similarly with newbuildings, both additional orders and cancellations, etc., are largely of supertanker size. The second vessel exceeding 100,000 dwt has now been launched in Japan, turning out to be slightly larger than her sister ship at about 106,400 dwt. This is almost identical with the size of the two ships being built in the USA, the keel of the first having been laid in late 1959. It now appears there are no definite plans to build further giant tankers at the Japanese yard which has so far produced all that are afloat. This is understandable. Of the seven 85,000-tonners, one has been idle since completion October 1958 and another idle since February 1959 after only a short trading period.

The remaining tankers above 75,000 dwt, all on order, comprise four of 87,500 dwt for tramp owners, two each in Germany and Japan; and 12 of 77,000 dwt for oil companies, six in Germany, three in Holland, two in Sweden and one in France. The 76,350 dwt tanker reported as contracted at a French yard by Norwegian tramp owners may not be a tanker as there are wide options. Further, one tramp vessel originally intended to be a 67,500-dwt tanker has now been definitely reduced to be a 40,000-tonner.

TABLE 5—Laid-up Tankers, by Month, 1960 (in 1,000 gross tons)

	World	British	USA
January*	3,172	560	354
February	3,164	584	399
March	3,160	560	382
April	3,335	676	376
May	3,350	660	366
June	3,645	729	328
July	3,810	761	321
August	3,770	732	317

*For the beginning of the month.

Sun Oil Co.'s $13 million, 50,000-dwt, "Pennsylvania Sun" which was built at the Chester, Penna., yard of Sun Shipbuilding and Dry Dock Co. and went into service last December. A twin, the "Texas Sun," was launched from the same yard August 24, 1960.

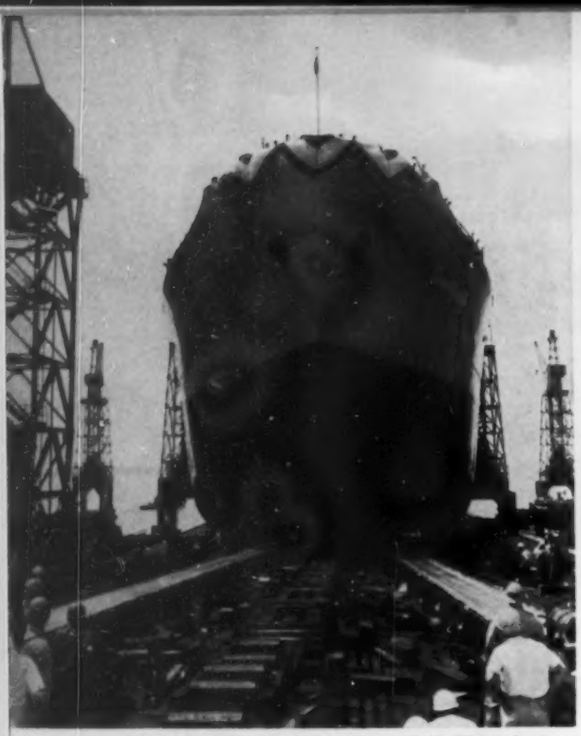
A report on world tanker construction at the end of the first six months of this year has been given in Lloyd's Register Shipbuilding Return. This shows 243 tankers of 100 gross tons and over, totalling 4,358,613 tons, to be under construction as of June 30, 1960. This is 293,547 tons less than on March 31, and it represents 47.8% of the total tonnage of all merchant ship building —9,124,175 tons.

Of the June 30 tanker total, 115 vessels are steamships totalling 3,193,508 tons, and 128 are motorships totalling 1,165,105 tons. Details of construction are shown in Table 8. Of the total tonnage, 1,005,484 tons are for registration in Great Britain and Northern Ireland, 513,355 tons for Liberia, 480,439 tons for Norway, 375,420 tons for Italy, 330,580 tons for the USA, and 260,603 tons for France.

The 1960 market. Taking a view from the rates recorded, John I. Jacobs and Co. feels that owners can hardly look on this year up to July as any better than 1959. Although the single voyage value for black oils from the Persian Gulf to UK Continent started off in January at a better level than the 12 months previously, the average of the London Tanker Brokers' Panel awards over the six months was only Scale minus 57½%, fractionally better than in the first half of 1959 but slightly worse than in the second half of that year.

The transatlantic average of Scale minus 53½% was virtually the same as for the whole of 1959. Up to July the transatlantic market had been the one mainly affected by backhaul tonnage, but substantial contracts

The "Achilles," a 712-ft, 41,000-dwt vessel with a capacity of 310,500 bbl of petroleum products, was delivered last summer to Newport Tankers Corp. by her builders, Newport Shipbuilding & Dry Dock Co. at Newport News, Va.



Gulf Oil Corp.'s 29,000-ton "Gulfoil," ninth of ten new tankers being built in a $120 million modernization program of its U.S. Flag fleet. She was launched in August at Bethlehem Steel's Sparrows Point, Md., yards. The ship has a capacity of 250,000 bbl of crude oil.

then recently concluded from the Black Sea to Japan with backhaul options have added considerably to the number of vessels tied to Persian Gulf loading and may cause the same influence to be felt to a greater extent in that area.

The half-year average for white oil carriers based on Caribbean Sea/UK Continent fixtures was Scale minus 37½% but values for this type of tonnage tend to be much more variable and on occasions substantially better rates were fixed for special requirements and in other trades.

Looking to the future, even though the picture from a rate angle is just as poor, factors are seen from which owners may derive a measure of encouragement. Chief among these is the volume of additional tonnage which it has been possible to employ during the early summer months when demand normally falls to a minimum. Other favorable pointers are that as a whole the oil companies have obviously not been overtonnaged to the same extent as last year or even to the extent the companies themselves foresaw, and there is also the fact that

TABLE 6—Ownership of World Tanker Fleet (2,000 dwt vessels and over)

	June 30, 1960		Dec. 31, 1959	
Ownership	1,000-dwt	T-2 equiv.	1,000-dwt	T-2 equiv.
Tramp	36,109	2,317	34,950	2,331
Oil company	23,369	1,379	22,572	1,321
Government	2,910	—	3,005	—
Miscellaneous	418	—	412	—
Totals	62,806	3,696	60,939	3,552

TABLE 7—Trends in World Tanker Construction (Vessels 2,000 gross tons and over. Under construction or on order as of:)

Date	1,000's of dwt
Dec. 31, 1957	37,407
June 30, 1958	31,332
Dec. 31, 1958	28,464
Mar. 31, 1959	26,379
Dec. 31, 1959	19,746

Middle East output in the first six months of this year is up fully 13% as compared with the first half of 1959 and 8% higher than in the last half. The global increases on the same basis are 5.8% and 4.1% respectively. It is true that at the moment there is a distinct tendency for production to outstrip consumption and create a surplus, but this must be infinitesimal in relation to total annual requirements now exceeding 1,000,000,000 tons.

Propulsion. The most interesting point seen is the progress being made in developing very large diesel engines with horsepower nearly matching that of the highest power turbine installations at present being used for tanker propulsion. It will take considerable argument to change the standpoint of firmly convinced protagonists of the merits of these two respective types of machinery. Certainly the much greater weight and dimensions of the giant diesel motor are a disadvantage. On the other hand, the far more economic consumption of such an engine operating on high viscosity fuel oil is undeniable and in turn this means that far less space has to be devoted to bunkers.

On balance, there is every likelihood that the availability of these high-powered motors will lead to a swing towards such machinery for supertankers, which have hitherto been so largely turbine; especially if there is parallel attention to developing high-efficiency pumping and heating equipment requiring only a minimum of steam.

Gas-turbine propulsion seems to have received something of a setback in the decision of one large oil company to lay-up the tanker on which they have conducted so much experimental work and not to proceed any further with this project.

TABLE 8—World Tanker Construction (As of June 30, 1960. Vessels of 100 gross tons and over)

Country of build	Gross tons
Great Britain and N. Ireland	895,175
Sweden	477,210
Italy	460,420
West Germany	406,919
Netherlands	348,836
Japan	345,800
France	322,208
USA	321,952
Denmark	231,350
Norway	135,589
Spain	131,314
Belgium	74,200
Yugoslavia	67,100
China	25,300
Poland	25,200
Portugal	19,250
Greece	16,270
Finland	3,300
Argentina	3,000
Turkey	420
Other British Commonwealth	49,970
TOTAL	4,358,613

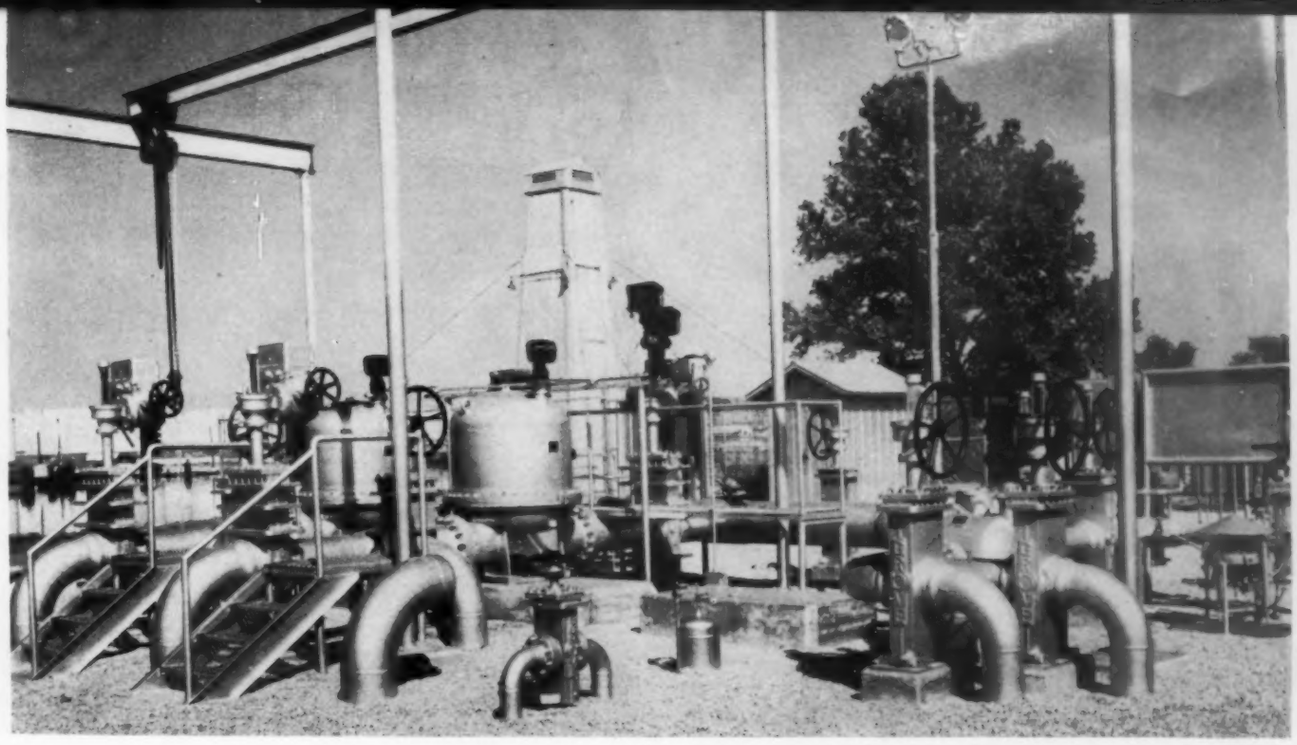
New Tanker Rules and a Nuclear "Safety Charter"

Before referring to the recent framing by Lloyd's Register of Shipping of a new "safety charter," designed to provide adequate safety protection for future nuclear-powered merchant ships and their crews, mention must be made of the new Lloyd's rules for oil tankers which came into force July 7.

While the immediate post-war increase in tanker size was taken into account by the revised rules of 1949, covering ships up to 620 ft long, these were not long issued before the society was being asked to class even longer tankers. The previous method of determining scantlings, based on a series of simple parameters, such as length, beam and draft, could not successfully be extended to these larger ships and a new method has been adopted, taking into account the stresses acting upon a ship and the particular features of its design. It is this method (described in Lloyd's Bulletin No. 3, 1960—"Lloyd's Register of Shipping and Large Tankers," by J. M. Murray, MBE, chief ship surveyor) which is embodied in the new rules.

(*Continued on page 88*)

Launched in April, the 47,400-dwt "Esso Baltimore" is the first of two new supertankers of this class to be constructed for Esso Standard Division, Humble Oil & Refining Co. by Newport News Shipbuilding and Dry Dock Co. Measuring 740 ft long with a beam of 102 ft, she has a cargo capacity of 417,840 bbl.



Meters replace tanks for custody transfer from pipeline to refinery. Pyramidal shaft in background is ventilator on a tunnel through which pipeline crosses a waterway

Recent developments in pipeline technology

by Elton Sterrett

A review of progress being achieved in automation and remote control, internal protective coatings, batch separation equipment, improved compressor drives, laying techniques, and maintenance

PROGRESS IS BEING MADE on all fronts in the technology of pipeline transportation. Advances in design, operation, and especially in automation, have not been confined to any single portion of the industry, being equally evident in the older lines carrying crude oil and petroleum products as in the newest branch of the industry, the natural gas pipeline.

And, within the year, if present plans mature, it will be necessary to include the pipeline transmission of solids as a part of the service contributed by the oil and gas industry's huge network of buried lines. At least one pipeline company is expected to enter the field already pioneered by the Gilsonite line in Colorado and the coal-carrier in Ohio.

Among the significant developments of recent months are these:

- Automation, remote control, and instrumentation in general, in a wide variety of types.
- Use of internal pipe coating for natural gas lines to help reduce corrosion.
- New techniques and equipment for batch segregation in product lines.
- Use of combustion turbines to drive centrifugal compressors.
- Methods for repairing underwater pipelines.

Automation and remote control continue to be installed to supplant operator supervised stations. Simplest, perhaps, is the case where electric motors drive centrifugal pumps or centrifugal compressors. However, the industry has come up with some surprisingly effective remote controls of satellite stations relying upon gas turbines or reciprocating internal combustion engines for prime power.

The truly automatic station, one which is controlled by changes in the material being transmitted by pump or compressor, is being closely watched by the industry as experimental units have proved their worth in areas far from other stations or at great distances from areas where personnel could be conveniently housed.

One such station, on a products line, employs two electric motor power units, each driving a multistage centrifugal pump. The control panel sizes up line conditions, and in the event of either fluid or pressure change or both, it will start one unit (in case the station has been down) or put the second on the line as hydraulic characteristics in the main change to require additional pumping power. The control has a further choice of putting the two pumps on the line in parallel or in series; again, strictly in accordance with the hydraulic requirements of that section of line within the station yard.

Still in early field-tests in actual pipeline operation, a power level controller for an unattended products line pump station promises a new approach to fully automatic, unattended stations which accept or reject load solely upon analysis of conditions within the fluid being pumped. The controller maintains, without outside assist-

Pressurized, inclined magazine stores spheroids until released by dispatcher, using an electrically controlled pin at lower end of straight run. Spheroids seal line between batches

New type of non-orbited sphere and disc device for batch separation in a products line

ance, the optimum power level of a station for most economical pumping of any predetermined volume. It eliminates such weaknesses common to satellite stations as communications failures, faulty operation from spurious signals transmitted by the communications system, and excessive burden on the central dispatcher's office. During the tests, the station in which the power controller is installed is being operated completely unattended and without communication links of any kind.

Natural gas pipeline compressor stations, handling a highly compressible and elastic material, find it more difficult to harness flow at a particular station through changes in the rate of flow or pressure change at the station gate. However, automatic regulation of such characteristics as surge control in centrifugal compressors points the way toward successful adaptation of related devices to the automatic operation of attended stations—retaining, of course, the equipment for remote control of such a station from a master station or the dispatcher's office.

Engine builders, pipeline station design engineers and manufacturing of control systems have worked together to make it as readily possible to start a distant multicylinder internal combustion engine as an electric motor simply by initiating a sequence of events through the pushing of one button or the turning of one key at the master station. One such satellite station, designed for peak service loading, incorporates a number of 2,000-hp, 4-cycle engines which not only can be started, stopped and supervised from the master station, but also can apportion the compressor load among the units being operated.

The recent installation of a satellite unit in a station in which existing units are now being manually controlled is believed to be the first application of a V-type, two-cycle engine driving a centrifugal compressor through a speed increaser. The 10-cylinder, supercharged engine, rated at 4,000 hp, is coupled to a single-stage low-ration high-volume compressor through a 15.3:1 ratio gear. This unit is completely self-contained. All power auxiliaries are driven through direct take-offs from the main engine. A concrete wall separates engine and gear from compressor. The other units at this site are of the four-cycle type, reciprocating compressors, at present manually attended.

Field compressor stations raise the relatively low wellhead or separator gas pressures up to the level required for injection into the main system. The development of self-contained, self-controlled units has brought about stations which will begin operation automatically when the producing well is put on the system, and which will continue to compress the gas until the incoming pressure or volume drops to a point below which the compression ratio is insufficient to boost the flow to the required pipeline minimum. Multiple settings of such skid-mounted complete power plants operate around the clock and across the calendar with no human supervision, or at the most with but one man on the premises. In conjunction with these automated field pressuring stations are separators and dehydrators also not requiring operating personnel.

Products lines, although pumping a fluid which is hazardous if allowed to escape, have developed the safeguarding of satellite stations to the point where the one man who puts in eight hours a day for five days of the week is primarily a yardman and a caretaker, his only visits to the pump room being to wipe up dust which may find its way in through the fiilters on the station ventilating equipment.

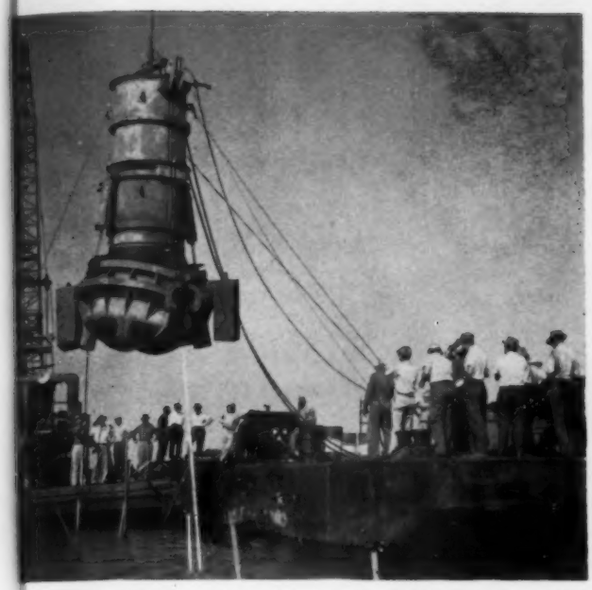
Internal coating of pipe, necessary to obtain satisfactory service life when handling sour crude throughput, has developed from an experimental status to a design requirement in many natural gas trunkline systems.

Mill or yard lining—especially of pipe 24 in. or more in diameter—with one of the vinyl polyesters is now specified on many new projects, as well as for pipe destined to go into loops in systems now being expanded. Development of methods of application and inspection now make it possible to secure a uniform coating around the entire circumference as well as along the length of a joint of pipe. Not only have there been large gains through corrosion reduction; there has also been a gain in daily volume delivered through a given size of internally coated pipe in comparison with a similar size of uncoated pipe.

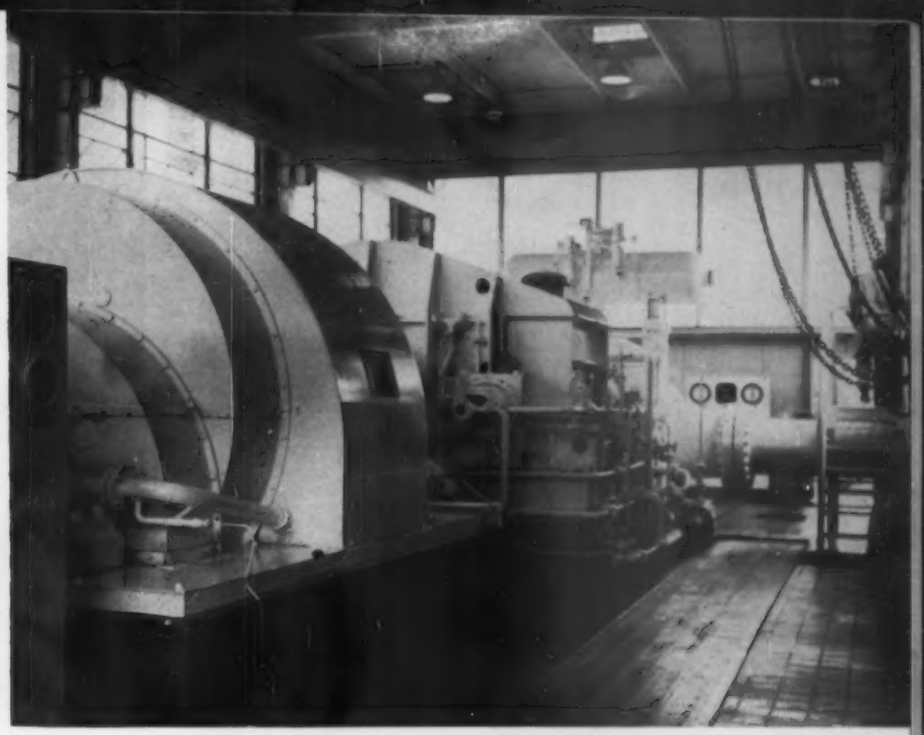
Batch segregation — especially in products pipelines—has also seen some advances. A hollow elastic spheroid, capable of being brought to a desired degree of firmness by pumping water into it, has been tested extensively in experiments to minimize batch front contamination.

Inflated to a diameter larger than the pipe in which it is to be used, the elastic material places a wide wiping band against the metal. It moves through the pipe by a combination of rolling and sliding, thus serving as a "squeegee" to wipe off any material adhering from the previous batch. Automatic devices have been designed to bypass these spacers at pumping stations so that the spheroid leaves the stream at the suction take-off point, and rejoins the stream at approximately the instant the slug of fluid from which the ball was taken arrives at the tie-in tee of the station discharge line.

The spheroids can be stored in a magazine attached to the initial station discharge



Repair caisson for servicing pipelines laid under water. Additional cylindrical sections can be added at top for use in deeper waters. Jaw openings are neoprene bushed



A 15,000-hp electric motor and companion gear box for drive in a natural gas pipeline station. At far end is discharge to centrifugal compressor. Assembly requires less space than a multi-cylinder unit

line, and released into the moving stream as desired by an electrically-operated control under the direction of the dispatcher.

Still another type of batch separator has been designed and given extensive service tests by the research and development sctionof one pipeline company. It resembles at its rear end the "dumbell" type widely used in products transmission and carries as its head end a fixed spheroid. The pressurized sphere is restrained by its mounting from the combination rolling and sliding which characterizes travel of a free spheroid. It is pushed through the line by a pair of standard pipeline rubber cups of the size for the line to be traversed. Since the diameter of the sphere is expanded by hydraulic pressure to ¼ in more than the interior diameter of the corresponding pipe, the contact area between ball and pipe wall is extended to form a band some 3 in. wide, which serves as a wiper seal to prevent comingling of the two fluids in the line.

Tests of this batching "pig" over a 107-mile span in one products line indicate that its use reduced the interface contamination to less than one-third that sustained with a dumbell.

Still another type of pig has been developed to obtain pressure gradients within a pipeline. Essentially it consists of four rubber driving discs on a common axle. The latter supports an instrument which records a continuous pressure survey as the device traverses a line. Presence of this pig midway in a line during a period of shutdown and restarting of a station recorded a series of surges within the fluid during the down period, diminishing in amplitude as the time lapse increased. Such a pig can also record such anomalies as a leak in the line, a leak repair, a check valve, or the pressure rise sustained by a drop in the line pressure as the pig passed under a stream.

Mixing crude and volatiles. It has long been pipeline practice to inject natural gasoline and other volatiles into viscous crude oils to improve the pumping characteristics of the stream. A development of this process, avoiding the cost of duplicate lines, has been to ship volatiles through the same trunk line which carries crude, mixing the two at the initial station and relying upon the receiving refinery to effect separation. This mixing has generally been handled manually—so many barrels of crude to so many barrels or gallons of volatiles—by opening or pinching appropriate valves. A result of this rule-of-thumb procedure has been that the problems at the refinery have been multiplied, and the line operated under conditions far from ideal.

One pipeline company's development laboratories solve this problem with a kinetic vapor pressure recorder-controller which automatically controls the natural gasoline injection rate so that the vapor pressure of the blend remains constant and at a pre-determined value. The instrument observes a change in vapor pressure and starts corrective action on the rate of volatiles flow within 25 seconds after the change occurs at the blending point.

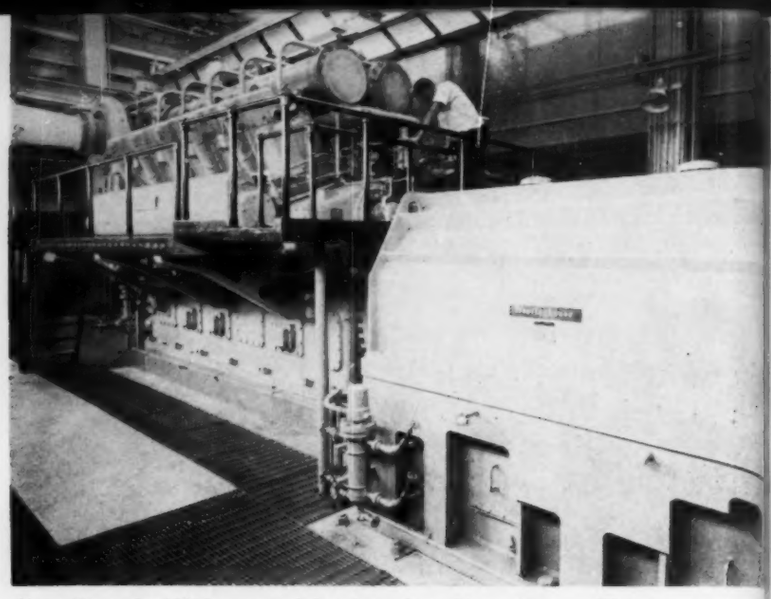
New turbine-compressor units. Two trunk gas pipelines are installing and testing units employing combustion turbines driving centrifugal compressors, both of which incorporate features at wide variance with normally accepted practice. The turbines, operating at speeds up to twice that of presently installed units, are either built in with or direct-connected to a compressor designed to mate with the drive and run at the same high speed. These units, with driver and compressor on a single skid base, require only a fraction of the station space now set aside for compression, even when employing electric motors and centrifugal compressors.

One of these units utilizes a modified airplane jet engine as power unit, the other a specially designed very high speed turbine which normally will be equipped with a heat exchanger to absorb energy otherwise lost through the exhaust gases.

Availability of driving units in the 15,000-hp range has placed added emphasis on the need for compressor units capable of transforming this energy into gas drive. Design considerations, including the range of conditions under which a trunkline must opearte during a year, render impracticable a centrifugal compressor with sufficient diameter to meet the need. An alternative already in service is a two-stage centrifugal unit following in basic principle the one already in use in one transmission sytsem. In this installation, back-to-back impellers on a common shaft within a double housing enable the unit to be run as twinned compressors handling large volume of gas at relatively low compression ratio, or, compounded through an ingenious looping of piping, to handle a smaller volume at a greater pressure differential.

Use of adjustable guide vanes in single-stage centrifugal compressors has been improved by the addition of electric motor positioning of the vanes with, in satellite stations, a position indicator which transmits this information to the dispatcher. Scope of adjustment of such vanes ranges from 20° counter to 70° prerotation.

Underwater repairs. Continued expansion of all three types of pipelines into the deep waters of the Gulf of Mexico has added emphasis to the search for a practical method of repairing such underwater lines, or of making an attachment without lifting the line to the surface for a con-



Above: Two-cycle, 4,000-hp, unattended engine and speed-increasing gear. The gear is of lock train design, with input and output shafts on the same centerline

Left: Geophone, analyzer, and man with sledge pounding on steel plate (background) enable a practiced observer to chart formations and possible sub-surface obstacles—valuable data for contractor before he bids on line construction

ventional type of repair of tie-in.

Underwater lines are laid without the slack and over-or under-bends normally put into a ditch-buried line. Consequently, an elevation operation would involve removal of mud overburden from a long section of pipe before sufficient length would be cleared for a lift to the surface without overstressing any section during the hoist.

To bring a pipe lying in 100 ft. of water to the surface without overstressing either the pipe or its corrosion jacketing would require the freeing of up to two miles of large diameter pipe and its adequate support during the working period, according to one estimate. The supporting of two miles of pipe at the surface, either attached to pontoons or suspended in slings between closely spaced barges, would require extensive—and expensive— equipment, and an absolutely quiescent sea, with neither tide nor wind. Even with an elaborate system of anchors, such an undertaking would be prohibitive in cost and subject the line to great hazard of rupture.

With such conditions in mind, engineers have continued to try to develop some type of caisson which could extend down from the surface, clamp around the pipe, be pumped free of water, and thus provide working space around the line. The two types so far constructed and used (but only in comparatively shallow water) require propitious weather, advance preparation at the site by excavating an area around the pipe ample to allow the caisson's clamping device to encircle the pipe without becoming mud-clogged, and adequate anchoring or bracing the tube to the surface so that currents, wave action and tides cannot impose excessive stress on the pipe.

Until some type of equipment is invented which will overcome the handicaps hampering present caisson units, their use in deeper water will continue to be circumscribed, and pipelines will continue to be laid from newly developed underwater areas to the nearest available platform, and there vertical risers brought to the surface for tie-in to existing systems.

Locating underwater lines. Without reference marks provided by visible objects, an underwater pipeline may deviate considerably from the surveyed route by the time it reaches its resting place in 100 ft of water. The floor of the Gulf of Mexico, for example, is far from being an underwater extension of some sandy beach. It consists of mud, ooze and debris—all of which to combine to give an uncertain line of demarcation between water and soil. A pipeline may sink many feet into this ooze before it finds sufficient stability to support it. It may shift sidewise considerably under the stresses imposed on it during the lowering-in process.

Locating such a line years after its laying may prove a serious problem. To speed such a search and chart the location of a buried line so as, for instance, to avoid laying a second line atop or across it; one oil company has devised an underwater pipeline location instrument which can be towed behind a surface vessel in the general area of the line.

The instrument records all metal objects it traverses. An electro-magnetic field, disturbed by the metal of a buried pipeline for instance, is calibrated to enable the charted record to measure the depth of a pipeline to within a few inches. Working from a buoyed initial point, repeated traverses of the locator not only indicate the depth at which a line is buried, but also its trend. Especially designed for work in salt water, its readings are clear and readily interpreted.

Although in effect "towed" by the vessel carrying the recorder, the locator actually slides along the bottom, a cone-shaped nose aiding it to ride over obstructions. The cable which drags the instrument also carries the wires completing the circuit between the electro-magnetic field in the "fish" and the chart machine.

Pipeline laying. Borrowing an expedient from the military, and following the precedent a year earlier when helicopters were used to fly microwave equipment into inaccessible (by normal travel) areas, one pipeline contractor flew joints of 24-inch pipe into a marsh right-of-way—a pay load of 3,840 lbs per lift—and averaged the stringing of 25 joints per hour by this means.

Another use of the helicopter was the placing of river weights—also in swamp terrain. Precision spotting was attained, and again the time element was sharply reduced over traditional methods.

Contractors also have found that the geologist's stand-by, seismic shock, can be adapted to the survey of near sub-surface conditions. Without explosives—simply the drop of a sledge on a steel plate-geophones gives a clear picture of the material which must be ditched before a line can be laid.

Light-weight or "thin-wall" pipe now finds a place in cross-country pipelines, because it cuts tonnage costs, reduces transportation expense, and is readily formed to the trench.

Development of the tip-up type of tower for suspended pipeline crossings has greatly reduced the problem of crossing busy waterways. The line, its supporting and wind-resisting cables and the towers are assembled at ground level and then all brought to final position as the towers are raised to design position.

Testing of pipe walls and welds, both circumferential and longitudinal, is now effected by the use of supersonics. Reflection of impressed sound waves, of an order beyond the capacity of the human ear, when picked up and recorded show through any anomaly the defect in the metal and allow it to be corrected or discarded without finding its way into the line where—eventually, it might cause failure. END

Technique for laying underwater flexible pipeline is illustrated in these three views of project carried out by British Insulated Callender's Cables Ltd. for Shell Oil Co. in Louisiana. At upper right, flexible pipe is reeled off drum on laying barge. Below, starting end is going over the stern skid on the barge. Above, Shell's collecting platform is seen beyond end of laying barge, to which it has been moored.

Flexible submarine pipeline for British Columbia project

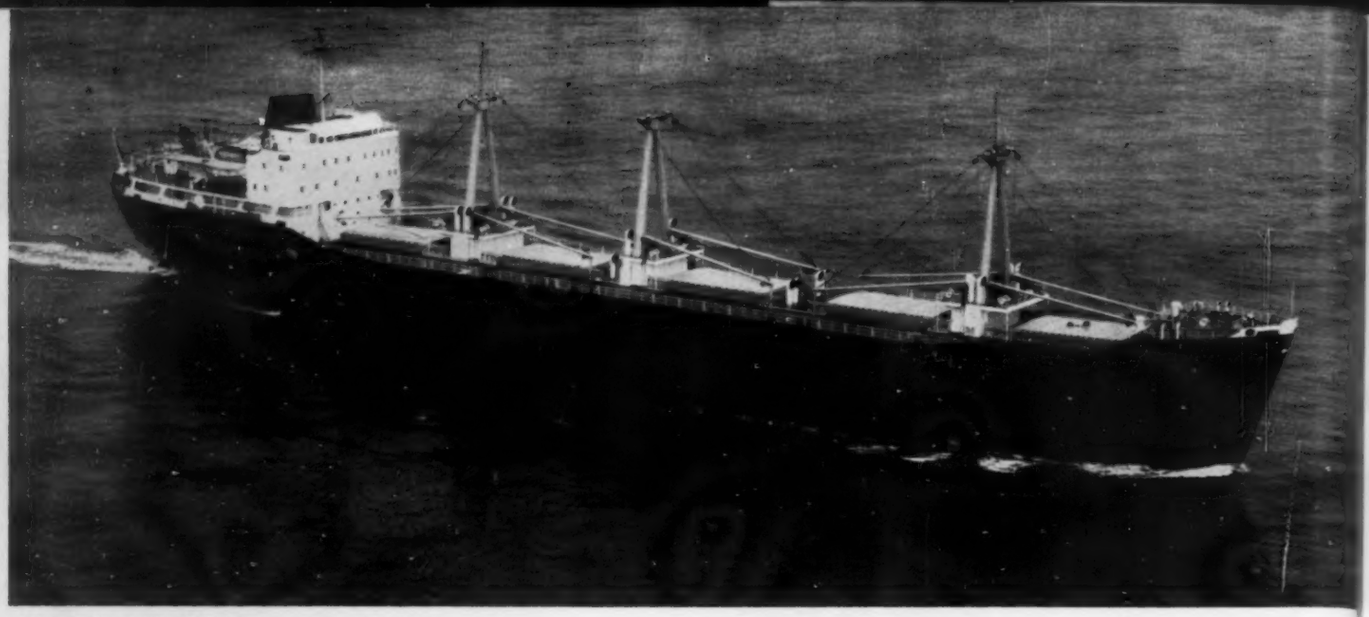
THE BRITISH COLUMBIA cabinet has approved the $13 to $14 million plan by Magna Pipeline Co. to lay a flexible submarine plastic steel line to deliver 30 mmcf/d of natural gas from the Canadian mainland to Vancouver Island, across about 25 miles of the Strait of Georgia—some 600 ft in places.

The project is due to be completed by June 1962 under an order of a Public Utilities Commission certificate of public convenience and necessity approved by the cabinet. Magna was directed to complete its contract with the British supplier proposed —British Insulated Callender's Cables Ltd. (BICC). The internal diameter of the pipe would be 4.85 in. and it would be laid along the contour of the crossing by cable ship.

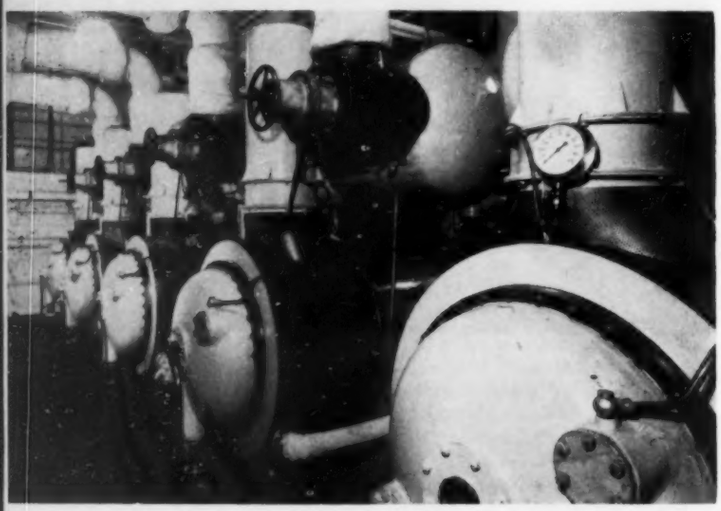
Recent BICC submarine installations include a 6,870-ft, 2-in flowline in the Gulf of Mexico collecting crude at 2,000 psi; a 2,200-ft, 1½-in line for Shell carrying gas in Lake Maracaibo at 3,000 psi; and a 910 ft, 3-in line carrying crude at 2,000 psi for Shell in Louisiana. In one operation only 32 minutes were required to lay a 6,370-ft length in water up to 43 ft deep.

This company can claim to be one of the pioneers in the production of flexible submarine pipe, having played a prominent part in the 1940's in developing the "Pluto" pipeline under the ocean which played such a vital part in carrying fuel under the English Channel for the invading allied armies.

Since then, the group has developed a range of flexible, reinforced plastic pipe which consisted basically of an inner plastic tube reinforced against internal pressure up to 3,000 psi by helically-applied steel tapes protected against corrosion by an outer plastic sheath. Where necessary, owing to the pressure of the teredo worm for instance, the line can be further protected by adding two bronze tapes and another plastic sheath; further, additional strength and protection can be given by the application of galvanized steel armor wire. END

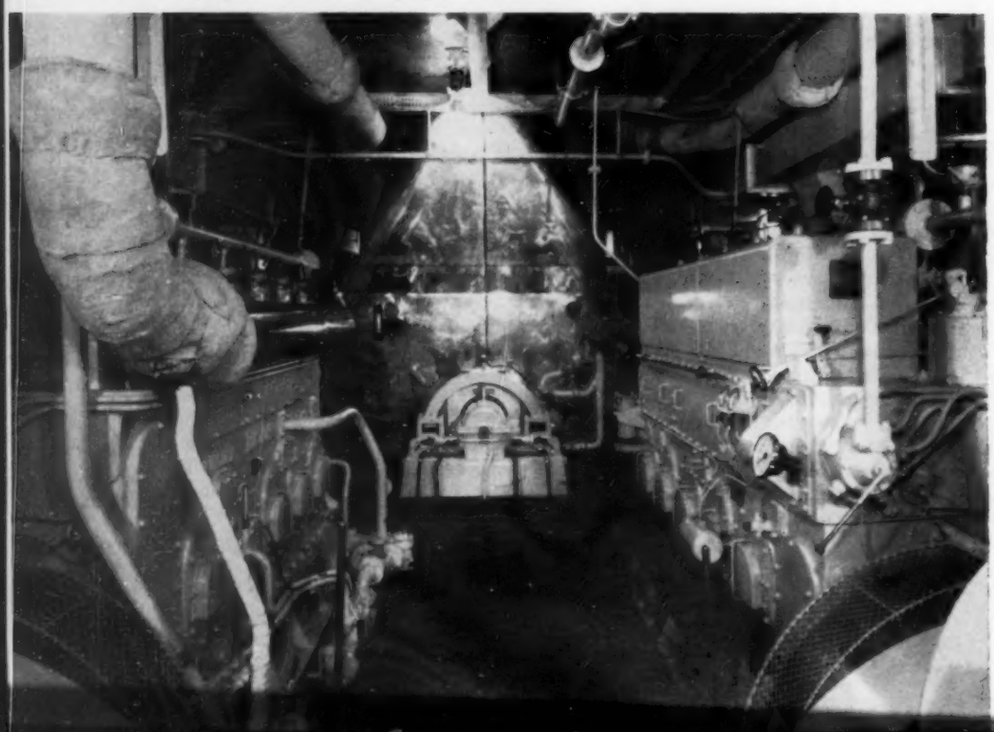


GTV "Rembrandt," a 12,900-dwt cargo vessel, is the largest ship to be powered by free piston-gas turbine machinery.



The five free piston gasifiers of the "Rembrandt" as seen from aft.

Main gas turbine on the "Rembrandt" as seen from forward, with main generator sets in foreground on each side.



New developments in marine transportation equipment

THREE SOMEWHAT out-of-the-ordinary vessels of British design have come to the attention of the marine transportation industry in recent months.

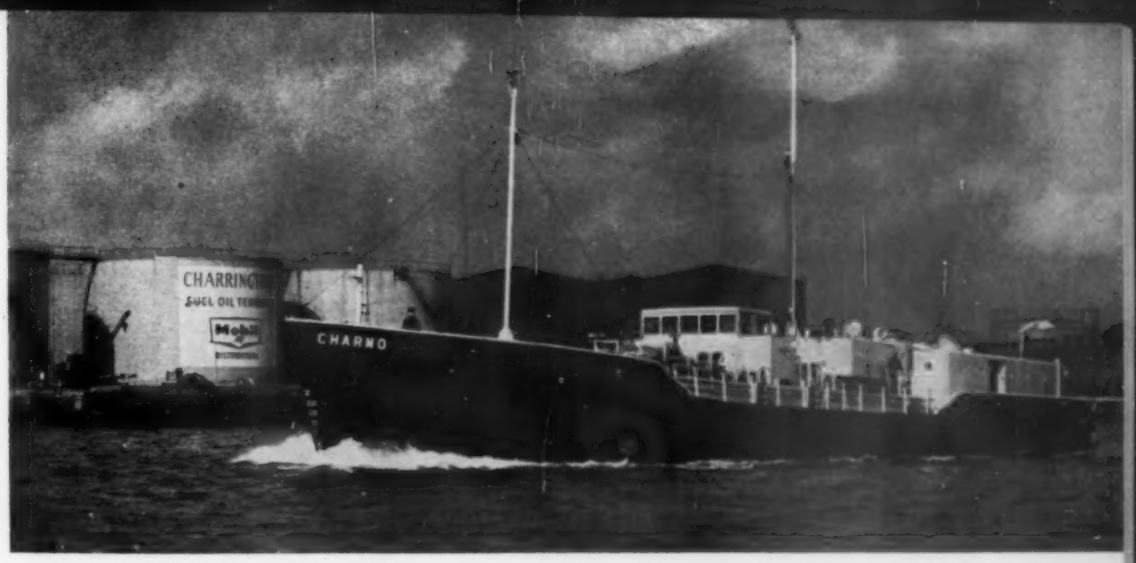
1. A small, 500-ton capacity, tanker for use in the Thames Estuary, which can complete a trip and discharge its cargo during all normal weather within the course of one tide.

2. Completion of sea tests on the world's largest vessel to be driven by a free-piston, gas-turbine, a 12,900-dwt cargo ship.

3. An especially designed production test barge and bunkering tanker for the Persian Gulf.

The MV "Charmo" is the 500-ton capacity tanker which was built this year by Charrington Gardner Locket (London) Ltd., at its Dartford works for its own use. Normally, this vessel will operate mainly between the Coryton refinery of Mobil Oil Co. and Charrington's oil depot on the Thames at Poplar. The paramount design factor was the ability to complete this river trip and cargo discharge in all normal weather in the course of one tide.

The "Charmo" has an overall length of



Charrington's new 500-ton estuarial tanker, the MV "Charmo," passing Poplar fuel oil terminal after discharging her cargo..

163 ft 3 in, breadth of 32 ft 6 in, and depth of 10 ft 6 in. Five hundred tons of fuel oil are carried on an 8 ft 6 in draft. The air draft has been kept down to 24 ft in the loaded condition.

A central wheelhouse has opening windows, all-round visibility being of high importance in the estuary. Steering is by Vickers Armstrong hydraulic gear, and remote engine control by Bloc Tube controls.

The after deck has the pumphouse in the forward part, with the crew accommodations behind it. The powerful Mirrless cargo discharge pumps have a capacity of 285 ton/hr, and are belt-driven through clutches from either main engine. Suction lines of 12-in diameter facilitate rapid unloading. The position of suction points close to the center line of the vessel and the after ends of the cargo tanks, along with the slight Vee section of the bottom, enables cargo to be cleared almost entirely without stripping pumps.

Heating coils in the cargo tanks are coupled to a 1 million Btu/hr Potterton hot water boiler. The boiler will probably be needed, however, only in exceptional circumstances, as the coils are also coupled via heat exchange with the main engine water jackets, which provide the necessary heat requirements when the engines are running.

Accommodations include mess room, galley and washing facilities, separate cabins for the captain, chief engineer and mate, and a combined cabin for the crew of three. Central heating for the accommodation as well as the wheelhouse is provided by a separate 60,000 Btu/hr Potterton oil-fired boiler.

A spacious engine room houses the two EVSM4 Lister Blackstone engines, providing 256 bph at 600 rpm, each on a 6-hr rating, coupled to a 2.5 to 1, oil-operated Modern Wheel Drive, reverse gear box driving a single, 4-bladed, 6 ft 6 in diameter bronze screw.

The twin-engine arrangement was chosen for flexibility and economy of operation. Cargo pumps can be driven by either engine. The vessel can operate at reduced speed on one engine for fuel economy when tide conditions permit. And one engine can at any time be given minor overhauls without taking the vessel out of service.

Engine cooling when cargo tanks are empty is by 7-ton internal skin cooled tanks, and gearbox and engine cooling by similar 9-ton tanks. Two 7-ton tanks supply fuel for engines and the hot water boilers.

A 33-hp Lister Blackstone air-cooled diesel auxiliary drives a 10-kw, 100-volt DC generator, the bilge pump, air compressor, and hydraulic pump. All auxiliary units are duplicated, the latter being driven by the main engines. A separate hydraulic pump, electrically driven, provides power for the steering gear, which can be alternatively connected to either auxiliary hydraulic pump. The electric switch panel has provisions for connecting to a shore supply if required.

The hull of the tanker is of all-welded steel of double chine construction with scantlings in excess of Lloyd's requirements. Anodic protection is provided for rudders, pipelines, and ballast tanks. Forward ballast tanks total 96 tons and are filled by 50-ton/hr hydraulically operated pumps. Deck machinery includes a hydraulic capstan aft and a hydraulic anchor winch forward.

Classification is to Lloyd's requirements, and all Ministry of Transport and Port of London regulations have been complied with or exceeded.

Acceptance trials of the "Charmo" showed a highly satisfactory degree of maneuverability and general control. In ballast, a mean speed of 10-1/3 knots was obtained on full power and 9¼ knots on one engine over the measured mile. Fully loaded, a mean speed of 8¾ knots was achieved.

The free piston system is claimed to offer shipowners an opportunity of making a new assessment of earning capacity as affected by capital cost, fuel cost, weight and space requirements of machinery, maintenance, and reliability. For this reason, the GTV "Rembrandt," largest ship in the world to be powered by free piston-gas turbine machinery is arousing keen interest among shipowners.

Built by Smith's Dock Co., South Bank, Middlesbrough, for the Bolton Steam Shipping Co., London, this is a cargo vessel of open shelter deck type of about 12,900 dwt, on 27 ft 8 in draft, with a designed sea speed of 13 knots fully loaded in average weather, and constructed to Lloyd's 100A class. She ran her trials recently off the northeast coast of England.

The main propelling machinery consists of five free piston gasifiers, four working and one standby, which supply gas to a single, non-reversing turbine. This is designed for a continuous maximum power of 4,000 shp at 110 rpm, using four G-34 type gasifiers, and a 1-hr overload rating of 4,400 shp is allowed for. At maximum continuous rating, the designed gas delivery pressure is 44.1 psig, and temperature is 869 F, to produce 1,230 gas hp per gasifier with a mean ambient temperature of 86 F.

All main engine components are designed to accommodate a gas delivery temperature of up to 950 F in extreme tropical conditions. On the test bed a gasifier specific fuel consumption of 0.326 lb/hr was obtained, the design consumption being 0.40 lb/shp/hr at the above maximum continuous rating. This design figure is based on the actual recorded test bed performance of the gasifiers and the prediction of the turbine and gear manufacturers for the performance of the turbine and gearing. The heavy fuel installation is designed to handle fuels up to 3,500 sec. Redwood I at 100 F (about 3,990 sec Saybolt Universal), and a Viscothers viscosity indicator is fitted to control the viscosity.

Total weight of the main machinery is 83.1 long tons. However, this is not of great significance for comparison purposes because the figure is influenced by the owner's requirements for auxiliary machinery in each particular case.

In the "Rembrandt," the total machinery weight of 420 tons includes all main and auxiliary machinery, pipes and fittings, oil and water systems, sterngear, tanks, ladders, floors and gratings, funnel and vents, spares, and stores.

The gasifiers were built by Smith's Dock Co. under license from Alan Muntz and Co., and incorporated design improvements resulting from recent research and the experience of the conversion of the 3,485-dwt "Goodwood" by Smith's Dock Co. in 1959.

This cargo ship was the first example of a British marine conversion to free piston-gas turbine propulsion as a private venture. As an oil burner, the machinery developed 950 ihp, giving a service speed of 10 knots with 10 ton/day fuel consumption. The free

Specially designed production test barge and bunkering vessel for use in Persian Gulf, the 810-dwt "Muthmirah," on her sea trials.

piston installation is capable of a maximum continuous output of 2,000 shp, permitting a relatively easy rating of 80% to 85% of continuous maximum for the desired service speed of 12 knots. This means an increase of speed of over 20% without an increase in fuel consumption.

In order to obtain a low idling fuel consumption in the "Rembrandt" and to avoid wastage of gas by blowing off in this condition, the machines are fitted with recirculation valves. These enable the gasifiers to match the turbine swallowing capacity over the entire pressure range. When idling with this device, the gasifiers develop only 20 hp each. It is thus possible to maneuver in restricted waters with extreme precision.

The main propulsion turbine, supplied by The British Thomson-Houston Co. Ltd., of Rugby, is of six-stage reaction type, arranged for uni-directional rotation. The design performance is summarized:

Rating	One Hour Overload	Maximum Continuous	
Number of gasifiers	4	4	3
Delivery pressure, psig	46.7	43.1	26.4
Delivery temperature, °C	482	462	365
Total mass flow, lb/sec	34.7	33.0	24.3
Output at turbine coupling, hp	4,600	4,100	2,000
Turbine speed, rpm	7,050	6,800	5,350

It will be seen from the table and the continuous maximum figures for the gasifiers that a pressure drop of 1 psi is allowed in the gas piping and a gearing efficiency of 97.5% is required to achieve the designed shaft horsepower output and specific fuel consumption. It will be further observed that it is possible to develop 2,000 shp with three gasifiers, and that in this condition, the limit is imposed by the maximum pressure attainable by the three gasifiers working on the fixed area of the turbine. The gas delivery pressure from the gasifiers is then 26.4 psig, and the three gasifiers are thus by no means fully loaded in this condition.

The 83 tons of weight of the main machinery in the "Rembrandt" is about 200 tons less than diesel machinery of equivalent power. It is estimated that the space and weight saved gives this ship an extra 200 dwt which can be carried in the form of profit-earning cargo. This should give an increase in earning capacity of about 1¾%.

A free piston ship should also be able to spend a longer period of her life earning money at sea, with less time in port or dock for repairs or maintenance. The fifth standby unit on the "Rembrandt" should allow normal maintenance and running repairs without loss of speed or earnings.

Although admitting that fuel consumption is still higher than that of a diesel engine of similar power, both the owners and the builders believe this will be more than offset by the extra cargo-carrying space and the maintenance savings afforded by the free piston system.

The especially designed test barge and bunkering tanker is the "Muthmirah," designed by BP Tanker Co. engineering small craft department for Abu Dhabi Marine Areas Ltd. (jointly owned by British Petroleum Co. and Compagnie Francaise des Petroles) for service in the Persian Gulf.

Built at Cleland's (Successors) Ltd., at Wallsend-on-Tyne, the "Muthmirah" has an over-all length of 180 ft, a breadth of 34 ft, depth of 12 ft, and a deadweight of 810 tons. Oil can be carried in three tanks divided port and starboard, and ballast water in side tanks.

Design and requirement of this craft is to test the crude oil from wells drilled by the "Adma Enterprise" in the Persian Gulf, and when not fully employed on well testing, she will transport gas oil from Abadan to Das Island.

The "Muthmirah" has a 7-ft diameter x 27-ft high separator upright on the deck, plus a flow tank, 14½ ft in diameter by 15 ft high. Crude oil enters the deck pipe forward on the vessel via a special flexible pipe which is coupled to the wellhead. It passes through the separator first, and the high pressure gas from the top of the separator is piped to the aft end of the vessel into a derrick pipe, the open end being over 20 ft from the stern.

The crude then passes to the flow tank, entering about half height at the port and starboard sides, flowing onto an internal gallery type of separator, releasing low pressure gas which passes to atmosphere through a high funnel. The oil is then metered prior to flowing into the cargo tanks.

Normally on shore-drilling installations, this amount of crude oil used for test purposes is burnt off, but one cannot pump crude oil on the sea and burn it. As no facilities are available at Das Island for taking the crude oil, the alternative is to pump it back in the well by means of a high pressure pump which is clutch-driven from the forward end of the main engine.

Salt water is then pumped through the deck pipelines, separator and flow tanks; the cargo tanks are washed; and the slops etc. are pumped back into the well.

A high pressure fire fighting pump is fitted which can supply water or foam to four monitors which are placed fore and aft; also hose line connections plus a foam line leading direct to the flow tank, this pump also deals with tank washing using a Maersk tank cleaning unit.

The four European cabins and Saloon are fully air-conditioned and the crew quarters and engine room are mechanically ventilated. Two electric galleys are fitted, a refrigerated room for meat and vegetables, a cold drinking water fountain in the Saloon and all cabins are lined with formica.

The machinery consists of an 8-cylinder Lister Blackstone diesel engine developing 660 bhp at 750 rpm. There are three 90-bhp Lister Blackstone diesel engines driving generators, general service pumps, hydraulic pumps and air compressors, fire fighting pump and cargo pump.

A Kidde CO_2 fire extinguishing system is arranged for the protection of the engine room and pump room in the form of a "total flood" system in each space. Every precaution has been taken to eliminate fire hazards by having all electric fittings and motors etc., gas and flame proof. There is no funnel on this craft, all exhausts from main engine and auxiliaries being led through water quenched silencers to the engine room ship's side.

This vessel has a speed of 9 knots, and with 140 tons of bunkers, she will be able to sail from the Tyne to Das Island in the Persian Gulf without refuelling.

The vessel is designed with side ballast tanks, to enable gas oil to be carried in the main tanks without being contaminated with water ballast, also the vessel can be in a ballasted condition when main tank washing is being carried out at the wellhead.

All deck machinery is hydraulically operated. The hull is cathodically protected with high purity zinc anodes. END

How coatings and anode systems help reduce tanker corrosion

Progress is reported, with good service and payout, in the use of inorganic zinc materials and synthetic resin coatings as well as with cathodic protection systems in oil tankers

SUCCESSFUL RESULTS in the fight against corrosion in oil tankers are being attained through the use of new and improved coating procedures and the use of cathodic protection, it was reported at the 1960 Annual Tanker Conference of the American Petroleum Institute.

The relative merits of each approach to the problem depend on the nature of the corrosion and the type of service in which the tanker is engaged. The two papers on coating systems were presented by technologists with California Shipping Co. and with the United States Navy's Bureau of Ships. The two on cathodic protection were by corrosion experts with Cities Service Research & Development Co. and with the Norwegian Ship Research Institute.

Coatings stop corrosion economically. A continually expanded program of experience with coatings as a means of corrosion prevention in cargo tanks of oil tankers has convinced California Shipping Co. (an affiliate of Standard Oil of California), that this technique will stop internal corrosion and do it economically. This was the conclusion reported in the API Tanker Conference paper by G. W. Colberg, manager of engineering and construction with the California firm. He emphasized that success depends upon proper surface preparation and coating application.

Mr. Colberg said, "In 1956, the expected life of the inorganic zinc vehicle coating we were using showed that the application and maintenance would cost approximately 14¢ per square foot per year versus 28¢/sq ft/yr for steel renewal alone. This 14¢ was based upon a heavily rusted tanker, with application costs of 90¢ to $1.00 per sq ft and recoating at 40¢ per sq ft. Life of the coating was to be five years and period of protection 10 years. Our coating applications in an original group of 20 cargo tanks are now four years older. Periodic surveys by our Richmond refinery materials laboratory now lead us to estimate the life of the coating at 10 years before recoating. On that basis, and assuming the cost of application to be approximately the same, the cost for 10 years' protection will be about 10¢/sq ft/yr."

In 1956, the company had coated a total of 20 cargo tanks with the zinc materials, as pointed out by Mr. Colberg. They now have 158 tanks coated completely. These ships with 100% coating have been almost exclusively in clean oil trade. In addition, they have 63 tanks that have had the horizontal surfaces in the bottoms coated in varying degrees. All of these partially coated tanks are in crude service, where accelerated pitting is usually experienced in those areas of the tanks.

The inorganic vehicle zinc coating is available in two types: a silicate vehicle which is self-curing, and a silicate vehicle which requires a chemical wash to set it. The self-curing type can be applied in a single coat up to 6 mils in thickness. The second type is limited in thickness to 2-3 mils for a single coat so that adequate curing is obtained from the chemical wash. Both coatings are characterized by insolubility in non-acidic petroleum products, including petrochemicals, but are attacked by acids or alkalies. The material can be handled with no worry as to toxicity and—except for some curing solutions—flammability. It has excellent bonding qualities and can be applied in one coat to the required dry film thickness.

The company is limited, of course, in the products that can be carried by the type of coatings it has selected. However, within these limitations and when properly applied, practically 100% protection against further steel loss on heavily rusted ships can be expected at the approximate 10¢/sq ft/yr cost reported. On new construction, the cost can come down to 4¢/sq ft/yr. The coating method is effective whether the ship has cargo aboard, is in ballast or is empty, without any action on the part of the crew.

Three additional intangible savings were cited by Mr. Colberg as being realized through tank coatings:

1. The ability to deliver cargoes free from contamination and discoloration.
2. The ease with which tanks can be cleaned, and savings in gas-freeing time.
3. Vapors do not regenerate as in heavily scaled tanks, and the tanks remain gas free.

Complete agreement with Mr. Colberg on his reasons for using coatings as the means to prevent corrosion was voiced by J. L. Liccini of the United States Military Sea Transportation Service during the discussion period following the California Shipping man's paper.

MSTS has not had sufficient experience with the zinc type of coating to comment on that particular material. However, Mr. Liccini did bring out that in their experience with a Saran type material on a large number of T-2 and T-1 tankers, they have

found the touch-ups were far lower than originally expected. As a result, they too have found the cost of protection on an annual basis is coming down. On a group of 11 T-2's, they had estimated touch-ups would cost $16,735 per ship. However, their records for the past four years, beginning in 1956, disclosed that the yearly touch-up costs have actually averaged only $5,506 per ship.

Many coatings were studied by the U. S. Navy. The Bureau of Ships has also carried on extensive work for many years on protective coatings, as reported in the API Conference paper by L. S. Birnbaum and E. A. Morgenstern, entitled "U. S. Navy Tank Coating Program." This work is being continued, particularly in the direction of finding a tank coating that would equal Saran in performance but eliminate the hazards associated with its application.

This coating, designated formula 113 (a vinylidene resin coating) was developed and proved to be a durable and resistant material for service with aviation gasoline and sea water with no effect on the gasoline itself. However, formula 113 contains 90 vol-% methyl ethyl ketone as a solvent, and MEK has a flash point of 30 F. It is because of the stringent safety precautions necessary when working with this material that the Navy continued its search.

A number of alternate coating systems have now been approved by the Navy for gasoline or jet fuel tanks and sea water ballast tanks. They fall into the following categories, the API paper said:

1. A five-coat formula 113 system applied at a total minimum dry film thickness of 6 mils. This material can be applied at low temperatures.

2. A five-coat proprietary two-part epoxy system containing high flash solvent, applied at a total dry film thickness at 8 mils. The first coat is a primer coat and remaining coats alternating white or orange.

3. A three-coat proprietary two-part epoxy system (high solids modification of system described in 2 above), containing high flash solvent, and applied at a total minimum dry film thickness of 8 mils. The system consists of a primer coat, followed by two finish coats and is a three-color system, the final coat being yellow.

4. A two-coat proprietary coal-tar epoxy system (black) containing high flash solvent, applied at a total minimum dry film thickness of 15 mils. This system is not recommended for aviation fuel tanks because it will discolor a clean fuel.

5. A proprietary inorganic zinc silicate type coating, applied in one coat and followed by a curing solution coat yielding a dry film thickness of approximately 2.5 mils.

6. A proprietary polyurethane coating system containing high flash solvent and consisting of a primer coat followed by three alternating white and gray coats applied to a minimum dry film thickness of 6 mils.

Combatting tanker corrosion by cathodic protection gives a very good pay-out, according to technologists with Cities Service Research and Development Co. A properly designed and maintained anode system within coastwise tankers could reduce presently known corrosion costs in specifically designed ballast tanks by about 75%, it was reported in the API Conference paper "Research Examines Tanker Cathodic Protection," by R. P. Blatchford and R. O. Norris.

In terms of dollars, an investment of $8,800 per year for 20 years on a T-2 tanker makes possible savings of $25,900 per year, which is a 74.6% reduction of uncontrolled corrosion costs, the Cities Service men stated. A similar percentage reduction can well be expected in larger tankers, they added.

These conclusions were reached as a result of field trials starting in 1955 of four different anode systems installed in the ballast tanks of the SS GOVERNMENT CAMP, a clean-oil tanker operating between New York and Lake Charles, La. Its voyages were typical of coastwise oil tankers: 7½ days in cargo, 4½ days in ballast, and one day empty.

The field trial yielded considerable useful information:

1. A typical T-2 tanker in coastwise clean oil service in the Cities Service fleet averages only 16% of each operational year in a ballast condition, of which 51.6% consists of sea water ballast. Normal ballast voyages extend 4.6 days when loaded with sea water, and last 5.5 days when ballasted with harbor water.

2. Total time in sea water ballast can determine the success or failure of any properly designed anode system. The use of harbor water ballast should be avoided whenever possible, because of its instability for producing adequate potential to all tank levels. Sea water ballast voyages must be allowed to extend four days to achieve adequate potentials throughout tank depths.

3. Anode systems should be designed so that anodes are spaced no further than 10 ft apart on all tank sides for those tankers engaged in coastwise service. T-2 tankers require current densities of 13.9 milliamperes per sq ft in the wing tanks, and 18 ma/sq ft in the center tanks. These systems should provide potential voltage readings varying between —.85 V and —1.00 V at all levels by the end of the fourth day in sea water ballast.

4. Individual anodes should be designed to provide maximum ampere output per square foot of surface area. Cross-sectional area and length should be large enough to provide a reasonably long life (three or more years). The use of several small, 60-lb anodes is much more beneficial, and lower in cost, than is the use of a few large 450-lb anodes.

The field trial indicated that enough anodes should be installed to provide the current densities indicated in the above paragraph 3, in the case of T-2 tankers, larger ships require more anodes because of the requirement for 10-ft spacing. However, the proposed anode system designed for T-2 tankers can easily be the basis for designing anode systems for use in larger tankers engaged in similar service.

The following information should be obtained before any anode system is designed:

1. Calculate the surface areas of the wing and center cargo tanks to be equipped with anodes.

2. Determine which tanks must be ballasted to achieve minimum motion, vibration, and pounding in moderate sea conditions, so that speed and fuel consumption will not be affected adversely. This will require several ballast voyages which include various headings into, abeam, and away from the direction of wave movement.

3. Measure ballast voyages between pilot stations. If the typical ballast voyage is less than four days, do not install anodes. Some other method, such as protective coatings, should be considered.

Although current density requirements may vary, the basic formula for calculating total amperage output needs does not change: A — CS/1,000, where A — total amperes required, C — current density demand at the cathode in milliamperes per sq ft, and S — sq ft of tank surface area.

Amperage output per anode depends on composition, length, surface area, and spacing. Measured outputs can be readily obtained from anode manufacturers. Quantities of anodes to be installed can then be determined to be a direct ratio of the total amperage requirement for any given tank. Formula: N — A/O, where N — number of anodes required, A — total amperes required, and O — amperage output per anode.

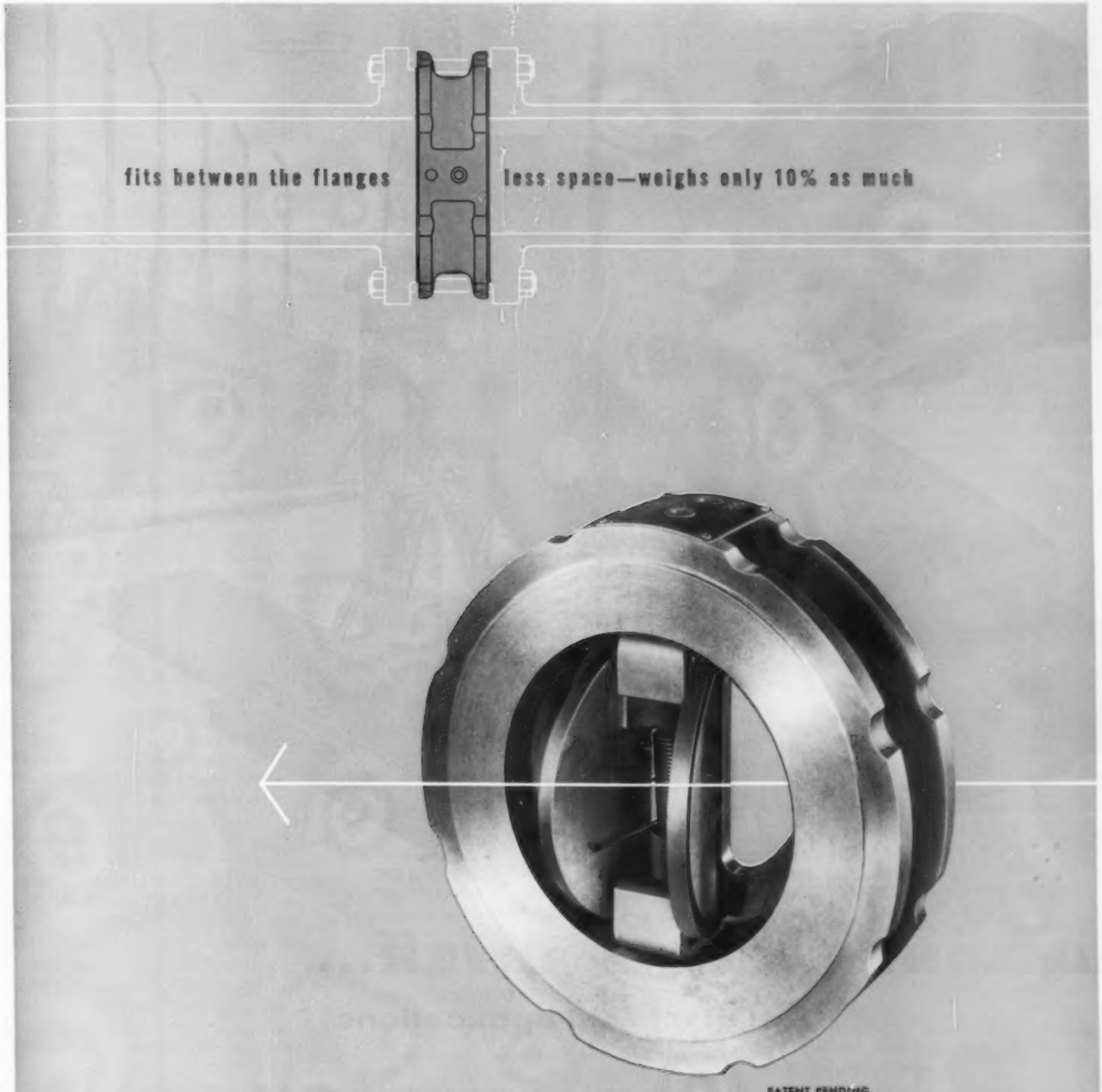
Calculations for the proposed T-2 tanker installation involved 60-lb anodes each having a 4.0-amp measured output. Tanks equipped with anodes at the prescribed spacing can receive sufficient reduction of corrosion throughout their entire depth, *if* most of their ballast periods consist of sea water extending for at least four days per voyage, such voyages to accumulate at least 16% of each operational year. The average coastwise T-2 can easily meet these requirements.

Potential voltage readings will be extremely high the first year the anode system is in operation. The formation of calcareous coatings permits more rapid polarization of tank surfaces, with subsequent reduction in current output per anode. The readings will drop rapidly after the anodes are more than half consumed. Experience has shown that anodes must be replaced when only 25% of the original material remains intact, because they are incapable of providing adequate potential.

Further research in the area of anode size is justified, the Cities Service people feel. It is possible that smaller anodes may provide equal protection with less current density at the cathode, less weight, and lower installation costs.

A comparison between 60-lb and 53-lb anode, for example, shows the following differences:

(Continued on page 55)



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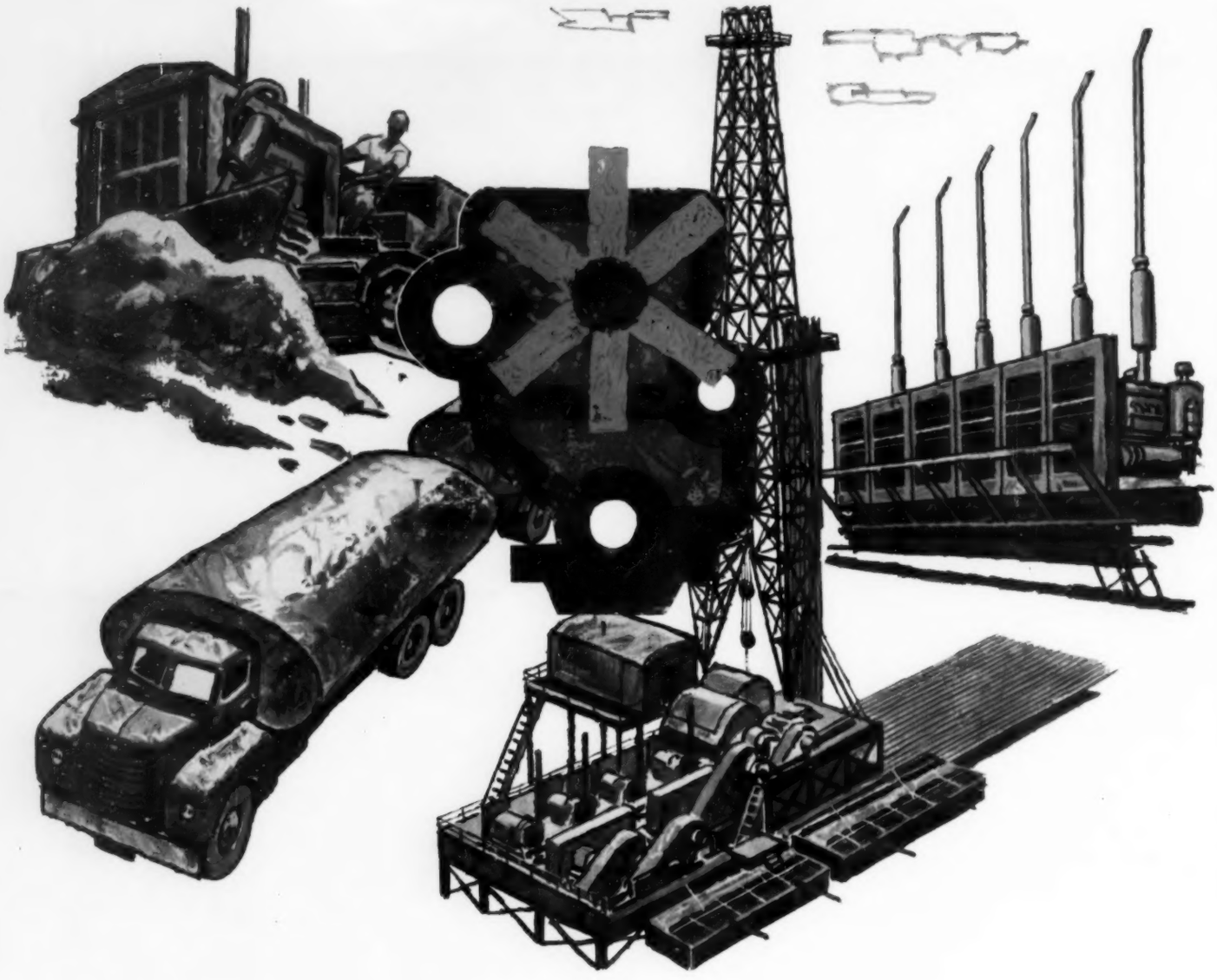

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(*Continued from page 52*)

Data	60-lb	53-lb
Dimensions, inches	34 x 5 x 5	16 x 7 x 7
Surface area, sq ft	5.07	3.79
Output, amperes	4.0	3.25
Cost (1956 price)	$24.00	$21.20
Estimated life, years	3.3	3.6

In a 32,500 ton tanker plying between the Persian Gulf and Japan, experience with 53-lb anodes providing less current density at the cathode indicated that these anodes are highly effective in that type of service. A worthwhile study could be made in a coastwise tanker by equipping two sets of tanks across with 60-lb anodes in one group and 53-lb anodes in the other group. If the 53-lb anodes proved equally effective, two additional advantages would be realized with their continued use: lower material costs, and less weight of the anode system.

An economic analysis of the anode system is based on costs all founded at the 1956 price level. First consideration must be given to the effective lifespan of anodes in coastwise tankers. This depends upon weight, current efficiency, consumption rate, length of time in ballast, ballast salinity, types of cargo, and so on.

Ballast time per operational year seldom exceeds 16%, and is never more than 20%, for the coastwise T-2 tankers in the Cities Service fleet. The consumption rate for 91% magnesium alloy anodes in sea water is 17 lb/amp/yr. An anode ceases to be effective when 75% of its surface area is consumed. With such known factors, plus a knowledge of individual anode weights and measured outputs, a formula can be devised for calculating the effective lifespan of an anode system.

This formula is $L = 0.75W/(17)(A)(0.20) = 0.75W/3.4A$; where L = estimated anode lifespan in years, W = anode weight, and A = measured ampere output.

Using this formula, one can predict with reasonable accuracy the lifespan of any anode in a properly designed system. The particular system involved, using 60-lb anodes, has a nominal life of about 3.3 years.

Coastwise T-2 tankers are normally provided with three tanks across specifically designated as ballast tanks to be equipped with anodes. Each of these ships thus requires 474 anodes weighing a total of 28,440 lb, at a cost of $11,376. Anodes are installed by the ship's crew, where possible, which roughly determines labor cost at about $2,000. The system must be renewed at least six times during the 20-year life expectancy of the tanker.

The total cost of installing and maintaining an anode system over a 20-year period in a T-2 coastwise tanker is therefore about $80,000; based on six times the original installation ($11,376 + $2,000 = $13,376).

Before the start of a corrosion control program in 1956, shipyard steel replacement costs averaged $500,000 per T-2 tanker; the ships being 11 years old at that time. A previous analysis, by R. S. Bassett of Cities Service Oil Co., indicated that uncontrolled corrosion could conceivably cost $1,330,000 per ship over a 20-year period, including the loss of cargo tonnage due to lay-up time for steel renewal work. It is necessary, however, to ascertain how much of this total cost could be the result of carrying ballast in non-protected, specifically ballast tanks.

There are 29 transverse bulkheads and 17 longitudinal bulkheads separating the various cargo tanks. With three designated groups, totalling nine separate tanks, 18 transverse bulkheads and six longitudinal bulkheads are directly involved as potential losses due to the carrying of ballast. This made possible the deduction that untrolled corrosion in non-protected ballast tanks over a 20-year lifespan would cost $694,000.

Another integral factor of total corrosion expenses—scale removal costs—were accounted for before 1956. They have since been fairly accurately assessed and should therefore be included in the total corrosion losses. Several chemical analyses of rust scale revealed that 60% of its weight (normally) consists of iron. The average weight of a bucket of scale is 25 lb. Scale from anode-equipped tanks contains calcareous deposits varying up to 32 wt-% per bucket of scale, and the weight balance of iron varies down to 40%. The balance of the scale consists of salts, volatiles, and oxygen.

The buckets of scale removed each year from two wing and one center tanks during the SS GOVERNMENT CAMP field trial totalled 883, weighing 22,075 lb, of which it is assumed that 8,830 lb (40%) was iron. Steel was priced at $106/ton f.o.b. Pittsburgh in 1956. On this basis, the lost scale was valued at $467.99. Extra labor costs were apportioned among the three tanks from the total charges for this ship, and these amounted to $943.17, bringing the total cost of scale removal in the subject tanks up to $1,411.16. The same costs can be expected in the proposed anode system.

Therefore, the annual scale removal costs in all anode equipped tanks are approximately $4,200 per year of tanker life, or $84,000 over a period of 20 years.

Approximately 10 tons of cargo carrying capacity are lost each trip throughout the effective lifespan of each anode installation, and the average coastwise T-2 tanker completes 25 voyages per year. The loss of capacity is due to the weight of the anodes. Projected over 20 years, this loss totals 5,000 tons. The USMC flat rate in 1956 was $2.40 per ton. Therefore, the use of cathodic protection costs an additional $12,000 in loss of carrying capacity over the 20 years.

If a new T-2 tanker, or its equivalent, is equipped with the proposed anode system, and if this system is maintained and properly ballasted, no steel renewal would be required in the ballast tanks throughout the 20 years of ship's life. The savings are balanced against the costs, as follows:

Steel renewal and lost cargo tonnage eliminated		$694,000
Anode costs	$80,000	
Scale removal costs	84,000	
Carrying capacity loss	12,000	
Total cost		176,000
Savings @ 20 years		$518,000

On an annual basis, the investment of $8,800 pays off in reduction of uncontrolled corrosion cost at $25,900.

Results of a study of corrosion in tankers operating in the Middle East crude oil trade was reported at the API conference by Ole Thome-Johannesen, head of corrosion department, The Ship Research Institute of Norway, Oslo, Norway.

This study had been carried out as a joint project by the Ship Research Institute of Norway and the Central Institute for Industrial Research between 1952 and 1957. The shipowners found that the practical results with cathodic protection were so satisfactory that there was no immediate need of further research.

Although the removal of oxygen from the ballast water by means of added sodium sulfite had given promising results when tested in the laboratory, the method failed to inhibit corrosion under actual service conditions, because corrosion was promoted by a sulfate reducing bacteria. Even in the absence of bacteria, this method does not seem able to prevent certain cathodic reactions, such as reduction of ferric oxide to magnetite, from taking place.

The paper did reveal helpful information concerning the nature of the internal tanker corrosion, which is summarized as follows (for both clean and dirty trade).

Clean Trade

1. General corrosion of cargo compartments is usually observed.
2. This corrosion is greater in the transportation of light than heavy products.
3. Corrosion of the deck plating and upper structure of the tanks is most pronounced.
4. Non-ballast tanks are more corroded than ballast tanks carrying alternately cargo and ballast water.

Crude Trade

1. Corrosion is characterized by pitting, accompanied by more or less pronounced general corrosion.
2. The seriousness of the pitting varies with the cargo, and seems most severe in tankers engaged in Middle East crude oil trade.
3. The pitting appears generally on the upper side of the heating coils and horizontal structures in the lower part of the tanks, and is moreover confined to places most exposed to spray during Butterworthing.
4. The pitting is much more severe in ballast than in non-ballast tanks, and is reported to be worse in tanks thoroughly cleaned prior to ballasting. END

Economic factors in marine transportation of LP-gas

The complex piping involved in an LPG tanker is illustrated in this view of the "Esso Puerto Rico," a 32,900-dwt vessel with a capacity of 80,423 bbls of LPG.

MARINE TRANSPORTATION of liquefied petroleum gas need not involve any major problems, provided a number of important factors are properly evaluated. Furthermore, lowest cost LPG transportation is obtained from vessels designed for low temperature and atmospheric pressure operation and should be combination LPG/bulk oil carriers whenever possible.

These conclusions were reported in a paper "Design and Operating Problems Involved in the Marine Transportation of LPG" presented at the 1960 Annual Tanker Conference of the American Petroleum Institute in Absecon, N. J., by Royden H. Rogers of Esso Tankers Inc. and John T. Kirk of Esso Standard Division, Humble Oil & Refining Co.

The important factors needing evaluation include: (1) the economic considerations affecting design of the ship, (2) considerations as to the hull design and the LPG tank design itself, (3) propulsion machinery, (4) instrumentation, (5) safety, (6) cargo handling, (7) crew requirements, and (8) gas-freeing operations. Of all of these, the economic factors are probably the most significant from a management viewpoint, and will be reviewed to some extent in this article. The Esso authors assumed, for purposes of their paper, that demand for movement of LPG has reached the point where it appears attractive to consider ocean transportation as a means to move it to market, that there is expected volume over a sufficiently extended period of time to come, and that supply and destination are both close to deepwater.

Once these foregoing general facts are established, the following specific factors must be studied:

1. The overall nature of the project. Will both ship and shore facilities need to be designed? If some part of the chain already exists, is the investment in it sufficiently great to make it a governing base point?

In the case of the Esso "Puerto Rico," the Company's most recent LPG tanker, facilities for handling the LPG already existed at the point of origin—Lake Maracaibo—a system of repressuring wells which could serve equally well to load tankers with LPG under pressure. Further, a project to store butane under pressure in caverns was under way at the Bayway refinery of Esso Standard, the ultimate destination of the butane. Therefore one of the many variables of the economic study was resolved.

The "Puerto Rico," presently operating in the western hemisphere carrying cargos of butane, butane/propane mixtures, butadiene, and various types of balance cargo, was constructed in Italy and delivered to the Panama Transport Co. in 1959. Originally contracted for as 35,550-dwt conventional tanker, she was modified before her keel was laid, to a 32,900-dwt LPG carrier. A total of 58 steel pressure tanks was installed, with a total capacity of 80,423 bbl of LPG. In each of the vessel's center tanks, four pressure vessels, 56 ft 6 in long and 16 ft 10 in diameter, were installed. Fitted into the upper wing tanks were horizontal vessels about 35 ft long and of varying diameters, permitting the carrying of bulk oil in the wing tanks below the flats on which they were installed. Balance oil cargo is also carried in the center tanks surrounding the large pressure tanks.

2. The volume of movement. Is it sufficiently high to justify operation of a ship solely to move LPG? If it is low, the operator may have to find a balance cargo to justify construction of a new ship or conversion of an existing one to handle LPG. Future growth must also be estimated.

3. Size and type of ship. Which would be better: a small fast ship or a larger somewhat slower vessel? Shore investment must be considered as well as inventory problems. At this point, the problems of cost of machinery, fuel and hull vs investment for cargo handling equipment must be reviewed. In the bulk cargo trade today it is almost axiomatic that operating costs go down as tonnage moved per unit goes up. However, this rule does not always apply in the rather specialized business of LPG shipments.

Another consideration determining size of ship is availability of substitutes. If a single large volume carrier were put out of service by a major marine catastrophe, and if no other means of supplying the consumer were available, it would be more prudent to have two ships of smaller capacity.

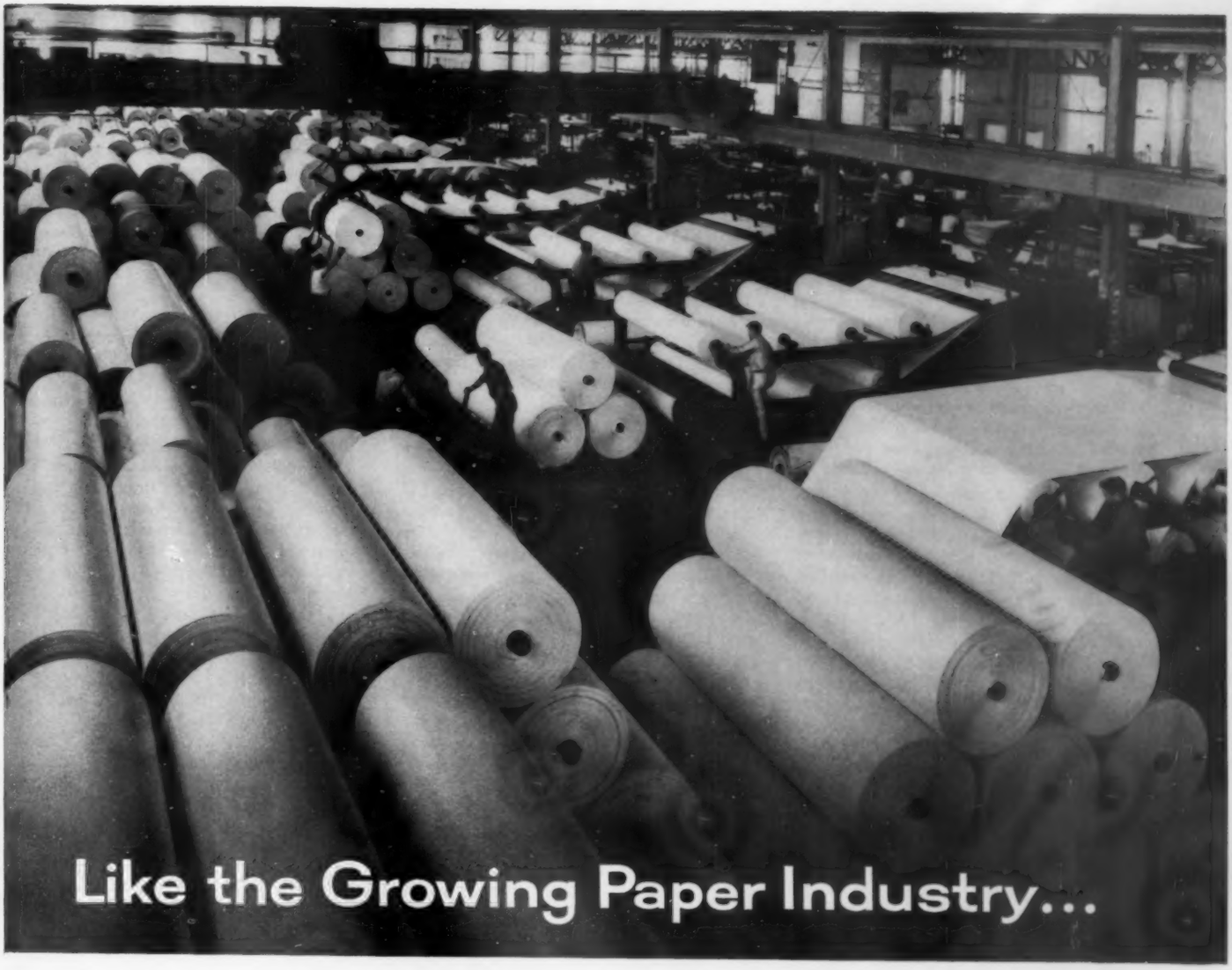
If at all feasible, consideration should be given to a combination carrier. By its nature, LPG usually calls for a petroleum cargo as its complement, although this may not remain universally true in the future. Is a parallel movement available? If not exactly parallel, is a movement possible between adjacent ports other than those for which the vessel is principally intended? If so, how much diversion and at what cost can the basic LPG movement stand and still be economical?

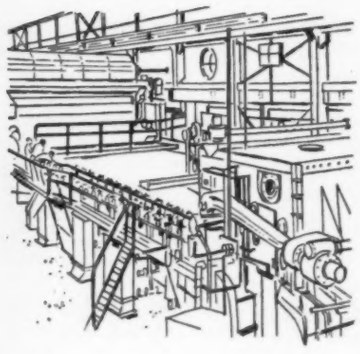
Since ballast must be carried for proper immersion on one leg of the voyage and provision must be made for containing and handling the ballast, a cost-conscious operator will seek means of using this space for handling other paying cargo.

4. Possible alternative cargos. There is no reason, if sufficient economic incentive exists, why LPG containers cannot be designed to carry other bulk liquid cargos—chemicals, vegetable oils, or normal petroleum materials. The operator who does not wish to confine himself to LPG or similar materials must keep these factors in mind in selection of ship design.

5. Selection of vessel. If the shipowner has a large fleet, he is faced with two choices: build a new vessel, or convert an existing or already contracted-for ship. There is no single answer to this question, since economics comes into play in each individual case. Generally, the conversion job is usually a compromise, the Esso authors feel.

6. Pressure system or refrigeration, or a combination. This requires finding answers to such questions as: What are the possibilities of future changes in product or trades? What range of each can be foreseen? Are there any materials with critical temperature characteristics that might be





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CITIES SERVICE

carried? Is a pressure system capable of reducing temperature by auto-refrigeration an answer?

The Esso studies to date show that under fairly normal operating and terminal conditions, the lowest cost installation is that designed for carrying LPG at low temperatures and atmospheric pressure. Only the very smallest LPG tankers show a contrary cost trend. This economic fact is of great interest, the authors said, because until the US Coast Guard "Tentative Requirements for the Transportation of Liquefied Inflammable Gases at or near Atmospheric Pressure" were issued about three years ago, low temperature atmospheric pressure type installations were not provided for in the USCG "Rules and Regulations for Tank Vessels," and the pressure type installations had the field to themselves.

One indirect economic disadvantage of a pressure type vessel installation is its greater weight as compared with a low temperature atmospheric installation of equal size. Esso estimated that a complete 110,000-bbl propane pressure installation, with tanks fabricated of A-212 or T1 steel, would be 40% and 30% heavier, respectively, than a refrigated low pressure installation comprising independently insulated tanks of normalized class "C" ASTM A-300 mild steel passing a 15 lb at —50 F Charpy test.

Pressure installations also require a somewhat larger tanker for the same quantity of LPG cargo because of the unavoidable waste space inherent in a cylindrical or spherical pressure vessel within a normal hull form.

Although a weight increase is not vitally important in a 100% LPG design, because the low density of the cargo and the inherent dimensional characteristics of any vessel prohibit operation at free draft, it is of great importance in the case of a combination bulk oil/LPG carrier because it will shut out balance cargo. A large weight difference also increases the installation cost in about the same proportion.

7. Shore facilities and ports. This question governs not only the type of installation, but also the size of the vessel and the balance cargo question. An operator with a steady trade between two ports providing full employment of his vessel has a simple problem. On the other hand, his vessel may be called upon to trade world-wide with a variety of products. The vessel can be designed to be self-sufficient, requiring no shore facilities; or it is entirely feasible for all cargo-handling equipment to be shore-based.

Esso's experience with the "Puerto Rico" has been that no two terminals are alike and that, because of her size, she is limited in the ports to which she can trade. On one recent voyage, this ship lifted an LPG cargo and balance crude oil, loading the LPG at one port from a pressure system, and the crude at a second port to a limited draft. Discharge of the crude and part of the LPG was carried out at one port and berth. Discharge of the LPG was to a pressure installation at a rate of about 4,500 bbl/hr. Because the shore compressors at this terminal were limited in capacity, the vessel's compressors had to be used on the vapor recovery system in order to maintain this discharge rate. The balance of the LPG was discharged at a second terminal—partly into refrigerated storage. Because the shore plant had a rather low pressure limit, auto-refrigeration was necessary as the cargo came ashore, and the discharge rate was limited to 500 bbl/hr. One thousand tons of the cargo were transferred directly to another LPG tanker equipped with a pressure system. The company, fortunately, does not foresee a repetition of such a voyage with its multitude of problems.

8. Use of LPG boil-off as fuel. There is an opportunity for relatively novel solutions in the design of propulsion machinery if consideration is given to using all or part of the boil-off of the LPG cargo as fuel for the main machinery or for other ship needs.

In a decision of this type, proper monetary value has to be assigned to the LPG vapors when used as fuel, and secondly, the quantity of boil-off available for use as fuel will be a function of the thickness of the tank insulation, insulation cost, and expected ambient temperature. Careful evaluation will also have to be given to the reliability and widely varying capital costs of different types of machinery that can be used for burning of dual fuels.

On a 35,000-dwt, combination bulk oil/LPG carrier, with one-third of the cargo by weight in LPG; and assuming a boil-off rate of 0.5% of the LPG cargo per day; the energy available for ship's use would be about two-thirds of the vessel's requirements for steam or gas turbine propulsion unit, and 90% of the requirements for a diesel propelled vessel.

If design considerations dictate that a residual portion of the LPG cargo (say 10% for a 15-day voyage) be retained in the LPG tanks to reduce thermal stresses by maintaining low temperature on the ballast leg of the voyage, then a small amount of boil-off would also be available for fuel purposes on the return voyage.

9. Manning an LPG tanker. As far as normal navigation and propulsion are concerned, the same basic requirements apply for deck and engine departments as on a conventional tanker. The steward's department would also be the same. It is in cargo handling that manning requirements will differ. A more highly skilled man than the usual pumpman is required to operate the machinery. Esso has found it best to carry an additional engineer whose principal duty is to oversee the operation of LPG pumping equipment. Although this licensed engineer is in charge of the pumproom, the actual cargo handling operation and overall supervision remains with the Chief Mate.

If the vessel is a combination carrier, then additional personnel will probably be necessary. The pumprooms for the two different materials are separate, the cargo systems are separate and are frequently operated simultaneously. Should auto-refrigeration be required during the voyage, as a prerequisite for safe handling of the cargo it will be necessary to provide sufficient personnel to operate the machinery on a watch basis.

Except for those men directly concerned with handling the LPG equipment, no major amount of training is necessary. Experienced tanker men can readily adapt to handling LPG. It is of course necessary to thoroughly indoctrinate the officers with the properties of the materials to be carried, the hazards, and the steps to be taken in various emergencies or unusual situations. It is also necessary to convince them that basically there are no unusual additional hazards because the vessel is an LPG carrier. Because of the many precautions taken, Esso feels that an LPG tanker is a safer vessel than a conventional oil carrier.

The other factors discussed by the Esso authors were of a more strictly engineering than economic nature. They included LPG tank and hull design considerations, insulation requirements for refrigerated type installations, instrumentation, safety, cargo-handling, and gas-freeing operations.

There have been four Esso LPG tankers, all built as pressure type vessels because they were designed prior to the issuance by the USCG of its requirements on low temperature atmospheric equipment.

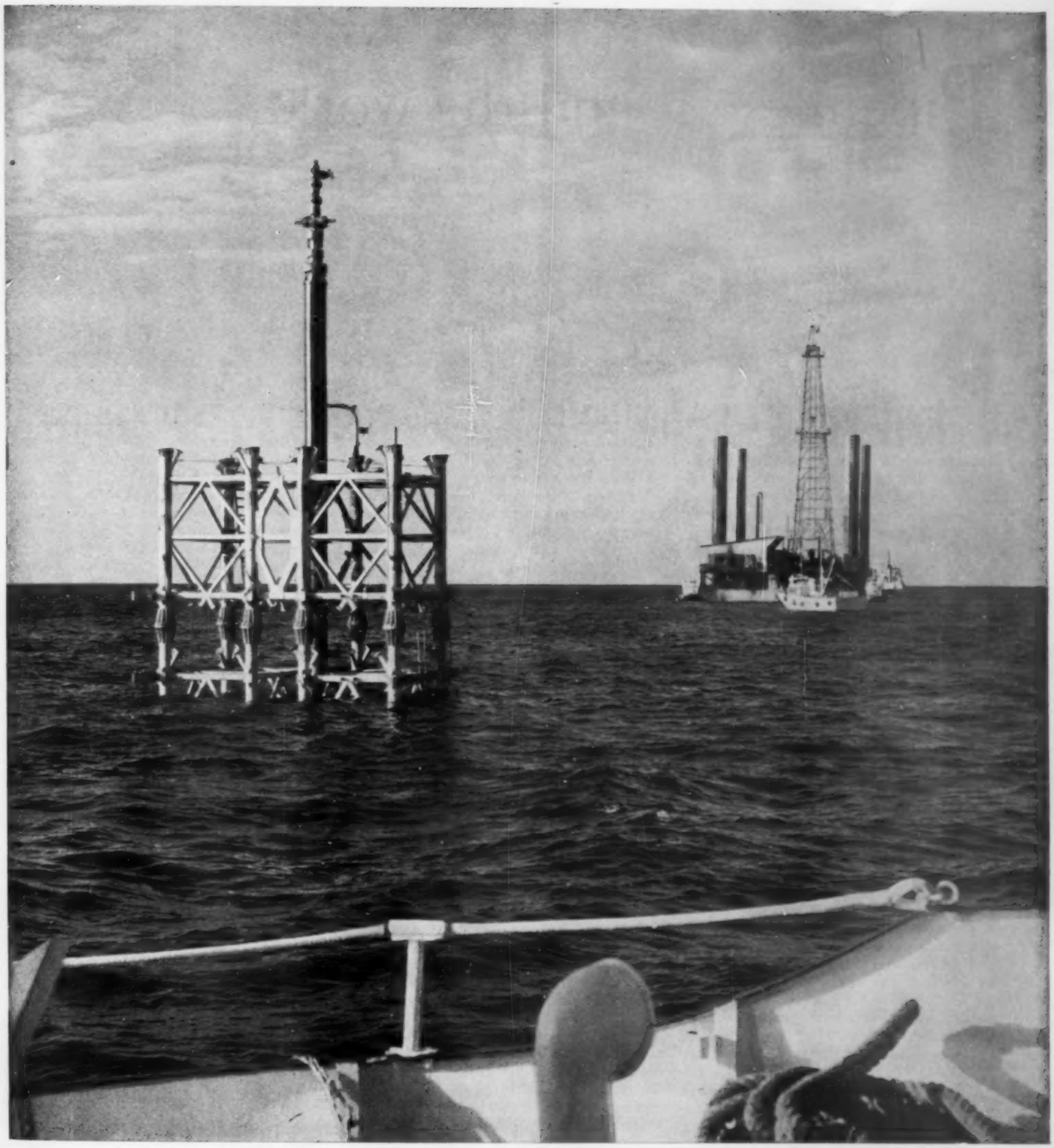
The first was the T2 Esso "Sao Paulo." In 1947, four vertical cylindrical propane tanks were installed in two of the ship's center cargo tanks. Each had a propane capacity of 25,000 gal and was designed for a working pressure of 300 psig. Space surrounding these tanks was used for other petroleum cargos. The initial installation proved successful, and four similar LPG tanks were installed in the "Sao Paulo" in 1949. All of these tanks were removed in 1954 and the vessel reconverted to conventional service due to changes in the company's marketing operations.

The second tanker equipped as a propane carrier was the Esso "El Salvador," a small lake type tanker used in South America. It was 255 ft long between perpendiculars and had a carrying capacity of 16,880 bbl as a normal tanker. When converted, an entirely new tank body was fitted, the new midship section being 14 ft longer than the section replaced. The tank body was divided into eight separate compartments, in each of which was installed an 11 ft 10 in diameter horizontal cylindrical propane tank. This provided a total propane carrying capacity of 138,000 gals. This ship was in service carrying propane and a balance cargo of light oils around the pressure vessels from August, 1947, to 1957, at which time it was sold.

The third propane carrier was the T2 Esso "Brazil," converted in 1948 by an initial installation similar to that of the "Sao Paulo." Four more tanks were installed in 1949, and still four more in 1951. All twelve of these tanks were removed in 1954 due to the same change in marketing operations as in the case of the "Sao Paulo."

The "Puerto Rico," described earlier, is the most recent addition to the Esso fleet.

END



ABU DHABI

A well head on the Persian Gulf. In the background, the barge "Adma Enterprise" which is currently drilling beneath the waters of the Gulf. The results are sufficiently encouraging to warrant the preparation of facilities for regular production. This stage should be reached by mid-1962.

BP

Pipelines around the world

Pipeline construction is continuing at a high level, with major lines underway in India, Indonesia, Middle East, North Africa and Argentina.

PIPELINE CONSTRUCTION shows no signs of slowing down, as companies spread their distribution systems around the world in expectation of a steady increase in demand. Outside the United States and Canada there are major projects underway, with activity concentrated in the Middle East and North Africa.

LATIN AMERICA

Principal new pipeline projects in Latin America are in Argentina, where the oil industry is growing rapidly under the impetus of industrialization. There are other projects of note, however, as new lines in Brazil and Chile can testify.

Argentina: Early this year the government's oil agency, YPF, inaugurated the first of a pair of twin lines, that will carry products and natural gas from Salta fields in northern Argentina.

President Arturo Frondizi was on hand for the opening of the 920-mile 12-in. oil section, which will move products to a terminal at San Lorenzo refinery, on the Parana River. The line will carry almost 58,000 b/d when all pumping stations and a new gasoline plant are completed.

The $200 million project is probably the first in which a long distance products line and a natural-gas line have been laid side by side. Both lines will be fed from a single gasoline plant, which will process gas condensate production from the Campo Duran and Madrejones areas.

Design capacity of the products line is 57,864 b/d. The chief product will be 34,342 b/d of 52°—gravity distillate, some of which is produced from Madrejones wells on the Bolivian side of the border.

Proposed deliveries of other products include 4,088 b/d of propane, 4,151 bbl of butane, 7,673 barrels of gasoline, 3,113 barrels of kerosine, and 4,497 barrels of gas oil and diesel oil. Until the new processing plant is completed, the products will be taken from a temporary plant at Campo Duran. Fish International Corp. was in charge of engineering and is supervising construction.

The Campo Duran project, as the lines from Salta to Buenos Aires are known, included a gas line 22 and 24 inches in diameter, some 1,100 miles long, in addition to the products line. The gas line delivers 243 million cubic feet of gas daily, and started operating on March 18, 1959. It increased availability of natural gas by 700%, and was developed by Gas del Estado, the government office in charge of gas development in Argentina. About 200 installations are planned by Gas del Estado to distribute adequately the 7 million cubic meters daily of natural gas from Campo Durán. Many of these are already in operation. The industrial gas line to Olavarría, a cement and lime zone in the province of Buenos Aires, was finished March 4, 1960 and an important ceramic industry began, based on gas. This gas line contributes to the solution of the power problems of the nation, inasmuch as it supplies the natural gas equivalent of 1,000 ton/day fuel oil, now consumed in Olavarría by the cement plants.

New construction includes the new 1,800 km gas line between Flanco Sud Cañadón Seco in the south and Buenos Aires, for the transportation of 10 million cubic meters of natural gas per day (353.1 mmcf/d). Expansion of gas services across the country's borders to supply natural gas to Uruguay, Paraguay and Chile is also now being studied by the technical offices of Gas del Estado.

Within a three-to-four year period, Gas del Estado will transport 23 million cubic meters of natural gas each day (812.2 mmcf/d), from fields in the north, south and west of the Republic. This compares with one million meters (35.3 mmcf/d) presently distributed.

Brazil: During May Petrobras, the government's oil agency, invited interested pipeline construction companies to bid on a Rio-Belo Horizonte pipeline. Destined to carry crude to a refinery to be built in the Belo Horizonte region, it will have an approximate length of 450 km, the difference of level between terminals will be 900 meters. Initial capacity (23 hours operation) will be 50,000 b/d. Services contracted include engineering, data, technical studies, specifications of materials and construction, detailed drawings, estimate and requisitions for purchase of equipment and materials. Construction and mounting of installations required for operation.

Petrobras also has concluded a contract with "Techint" to build another pipeline in the Bahia Reconcavo, 32 miles long, to link up the newly-discovered fields of Buracica, Cassarongongo and Taquipe. The first 15 miles have been completed and Cassarongongo will start producing when the last 17 miles are completed. The three fields had 39 producing wells as of June, 1960.

Pemex has completed the Arraial do Cabo pipeline, destined to carry fuel oil to industrial installations, including the Cia. Nacional de Alcalis factor, and others.

Bolivia: The country has a highly developed system of pipelines, leading to the Pacific at Arica and connecting major oilfields. They total about 765 miles of crude pipelines and several others are planned. No construction work is going forward on planned lines at the present, however.

Chile: A network of pipelines in the Magallanes area was extended early in 1960 by a products line of 120 kilometers in length between the Concon refinery of ENAP, the government's company, and Santiago. It was constructed by the Soc. Nacional de Oleoductos, known as Sonacol Ltd., whose capital was contributed by Cia. de Petroleos de Chile (Copec), Esso Standard Oil Co. Chile, and ENAP.

AFRICA

Northern Africa holds the center of the stage as large discoveries there continue to reach deep water via new lines.

Angola: New small-diameter pipeline began moving crude early this year from new field discoveries in Angola.

Petrofina is building a 3-in. and 4-in. pipeline from two finds in the Quissama Game preserve, southeast of its existing production on the coast of the southwest African colony.

A 3-in. line has been completed from Gaslinda to Bon Jesus, on the south side of Cuanza river, where the second field has been found. A 4-in. line will run from Bon Jesus to a pipeline already connecting Benfica field and Luanda, where Petrofina operates a small refinery. The first stepout to the Bon Jesus discovery is in progress.

Petrofina produces about 1,200 bbl. daily from Benfica, Luanda, and Cucuaco fields,

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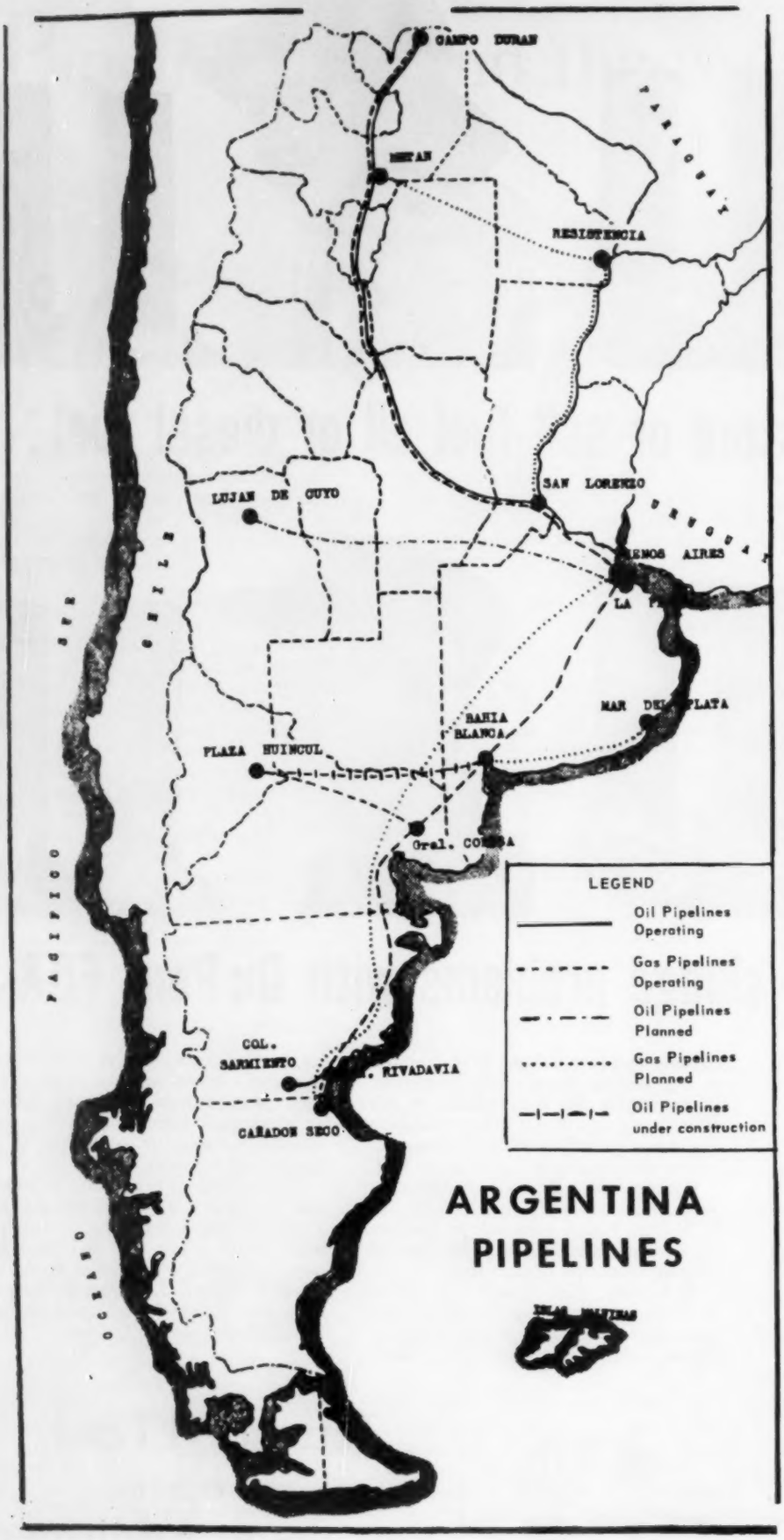


all of which are located near the coast, in the vicinity of the town of Luanda. Most of the output is from Benfica.

Algeria (OCRS): There are two major crude lines in Algeria. Finishing touches have been put on "Le Grand Pipe," where French construction crews starting in April, 1958 and finishing 21 months later, have built 660 kilometers (410 miles) of 24-inch oil pipeline from the Sahara to the Mediterranean Coast. Two French firms, Entrepose Co. and Ste. Parisienne pour L'Industrie Electrique formed a subsidiary company, Groupment Entrepose Parisienne pour L'Industrie Electrique (GREP), to build the oil carrier. The line is operated by Ste. Petroliere de Gerance (SOPEG) to carry crude from the large new Hassi Messaoud field to the Mediterranean port of Bougie, about 130 air miles east of the city of Algiers.

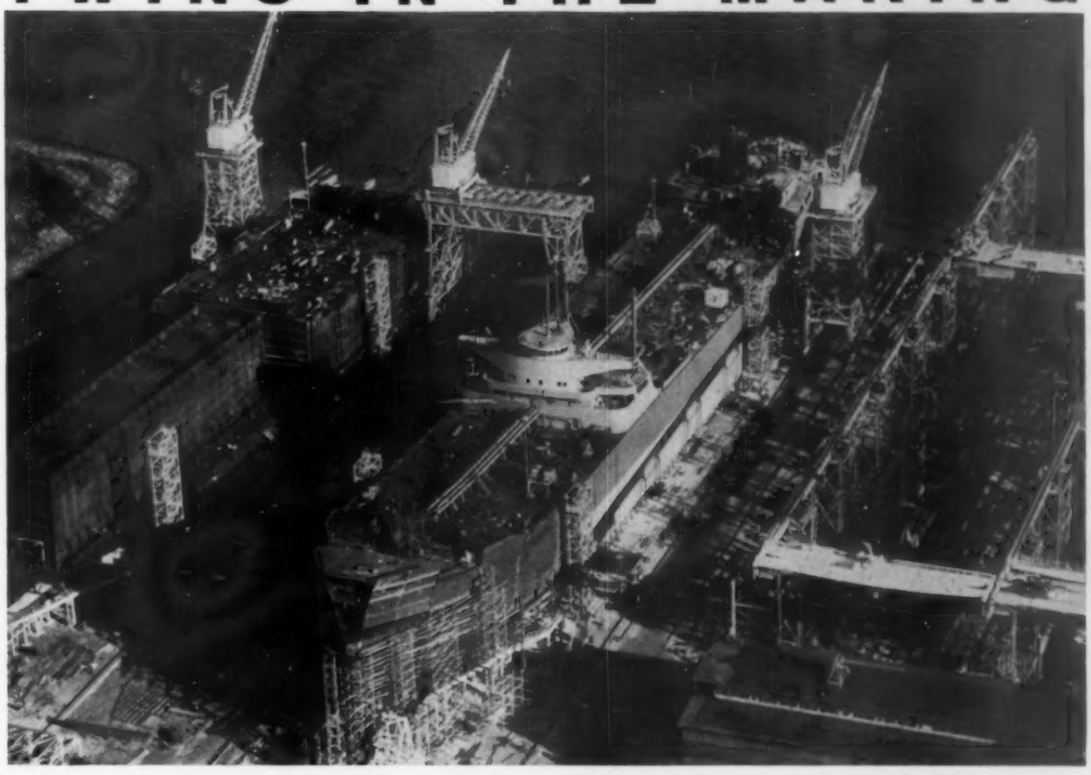
The line presently has gathering facilities and a pumping station at Haoud el Hamra, near the Hassi Messaoud field; a pumping station at M'sila, along the line; and a storage and tanker loading facility at Bougie. Paralleling the line is a black top road built so that drifting sands do not block passage. And where there were no works of man at the M'sila site, that station now boasts air conditioned crew living quarters and a swimming pool.

The second major pipeline to come out of the Algerian Sahara was to begin operations during late September 1960. CREPS, the French operator in which Shell has a 35% interest, announced that test runs had begun in the 485-mile, 24-inch pipeline to the Tunisian port of La Skhirra with only one temporary pump station operating so far. The line is known as the Zarzaitine-Mediterranean Pipeline, since it begins in the Zarzaitine fields of CREPS. TRAPSA is the constructing company, and it is headed by the president of CREPS, Mr. Paul Moch. The line goes through Tunisian territory, under a private convention signed with TRAPSA and the Tunisian government on 30 June 1958.

Contract has been awarded by SN Repal for a 24-inch gas pipeline from Hassi R'Mel to Tiaret, some 200 miles. Mapping has started on the route of the natural-gas pipeline to the Algerian coast from Hassi R'Mel. Work began, February 15, at Saint-Leu, near Oran. The first link of the Saint-Leu-Triaret line will be 110 miles long. The second link, Triaret-Hassi R'Mel, which was started in March, will be 205 miles. The line is scheduled to be completed from Hassi R'Mel to Saint-Leu by the end of 1960. Initial testing, therefore, will take place in about one year. Official opening is scheduled for April 1961. At that time, the Ste. EGA (Electricité et Gaz d'Algérie) will have established at Saint-Leu the branch lines from the Oran region and, at Relizane, the branches to bring gas to the Algiers region. The Bone area will be served at a later date.

The Hassi R'Mel-Saint Leu natural-gas line has a diameter of 23.62 in. to Relizane and 19.685 in. from Relizane to Saint-Leu.

TWINS IN THE MAKING



Two supertankers are shown on the construction ways at Sun Ship Yard in Chester, Pennsylvania.

These 50,000-Ton supertankers are the PENNSYLVANIA SUN now in service and the TEXAS SUN recently launched and now at a fitting-out pier being made ready for service. These vessels are 745 feet long.

Sun Ship is now prepared to build larger vessels and will continue to meet the increasing demands of the shipping industry.

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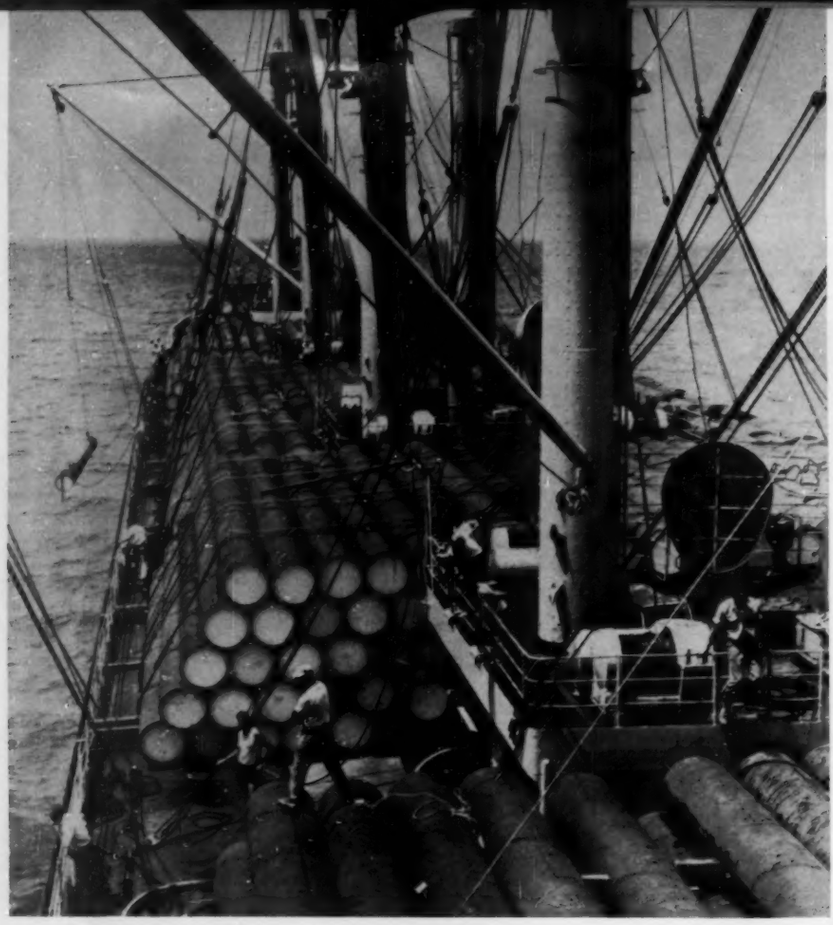


The first of 2,000 lengths of pipe is carefully lowered over the side of the ship (center, left) by Esso Libya. Rough seas made the operation difficult.

Here the first pipe, the sealing plug still securely in place, is rolled onto the huge truck which will take it to the storage yard. Soon it will become part of a 100-mile pipeline to Esso Libya's oil field at Zelten, in the south.

Esso's pipe was towed by small boats. The operator delivered the pipe he brought in to the shore crew. Carefully-trained Libyans, shown here, are placing the huge pipe on a special car on a marine railway, and chaining it in place. The next move will be to pull it up on the dry land with steel cables.

Capacity will be from 4 to 5.25 billion cubic meters per year with a full load. Algerian needs presently are about 650 million cubic meters.

Natural gas from the Sahara to Europe in the form of liquid methane may flow via new internationally owned company which will build a plant to liquefy gas from the big Hassi R'Mel gas field. It is due for completion in 1963-64 on Algeria's Mediterranean coast near Oran. Initial output will be 29.5 million cu. ft. of liquid methane annually to be doubled at a second stage.

Conch International will have a 50% interest in Camel, the company that will build the gas liquification plant and sell the liquid methane to customers with their own means of transport.

Libya: There are no pipelines in Libya at present, but two major lines are to be constructed soon. Ohio Oil Co. heads a group of USA oil companies which filed a proposal with the Libyan government to build a 122-mile crude pipeline in that country. P. L. Henderson, president of Ohio Oil International of Libya, said the line—which will have a daily capacity of 300,000 bbl—will extend from the Dahra area to the Gulf of Sirte. Construction will require 18 months to two years. The "Oasis" group (Ohio Oil, Amerada, and Continental) will be joined in the project by Esso Sirte (SONJ subsidiary) and Libyan American Oil Co. (Texas Gulf Producing subsidiary). Tanker berthing and large storage facilities are included in the project.

Delivery of 40-foot lengths of oil pipeline pipe, the first ever used in Libya, has begun at Marsa El Brega on the Gulf of Sirte, by Esso Standard (Libya) Inc., an affiliate of Standard Oil Co. (New Jersey). The 30-inch diameter, 4,000-pound section of pipe is the first of its size ever to be unloaded from a ship anchored in the open sea and towed to the beach. The idea has worked, but it was not without its initial headaches, especially when some of the plastic plugs did not hold. The pipe was part of a full cargo of pipeline sections which arrived by sea from England with each section securely sealed with a large plastic plug.

In addition to building the pipeline, Esso Libya is also planning to build a loading terminal at Marsa El Brega, so that crude oil can be delivered directly aboard tankships for transportation abroad.

Esso hopes to be shipping crude abroad by 1962. The company has announced that Bechtel Pipeline Construction Company will build the pipeline. The present task of unloading the pipe and stacking it on the beach is being done by SAASCAM, a Libyan construction firm, under contract to Esso Libya.

Nigeria: A new pipeline to carry oil direct to the coast from all the oilfields in the eastern region of Nigeria will be operated by The Shell-BP Petroleum Development Co. of Nigeria Ltd. The 12-inch diameter pipeline, constructed for Shell-BP by The African Construction Co., runs from the Bomu Field, 35 miles east of Port Harcourt, to a new ocean tanker terminal at Bonny, at the mouth of the Bonny River. The 18-mile route of the line is through bush country and mangrove swamps. For the last ten miles the pipeline is laid on the bed of the Bonny River where it is covered by 70 ft of water at its deepest point. To avoid corrosion it is wrapped in fibre glass impregnated with asphalt. Completed in May this year, the pipeline has an ultimate carrying capacity of over 80,000 b/d.

In the meantime, the terminal at Port Harcourt, 40 miles up river, continues to deal with oil produced at Oloibiri and in both the Bomu and neighboring fields of Afam. Construction was completed in December 1959 of a 14-mile, 12-inch pipeline from Bomu through bush country north to Afam and there connecting with the original Afam-Port Harcourt line. Built at a cost of some Sterling £250,000 its completion means that oil from the Bomu field no longer has to be brought partly by barge to Port Harcourt. When the direct line, Bomu-Bonny, is finished all production will be piped direct to the marine terminal at Bonny.

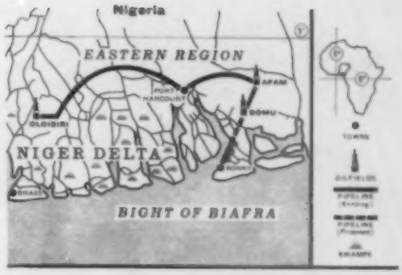
MIDDLE EAST

The Arab League has endorsed for the third time the Arab-owned pipeline proposal to the Mediterranean. It would cost some $720 million, and transit about 1,250,000 b/d of oil daily. Financing is the big hurdle, and it has not been surmounted yet. The same idea was advanced by the oil companies some time ago and eventually abandoned after Suez was reopened and tanker rates declined. One of the basic reasons for its dismissal then was the feeling that tankers provide a much more flexible and secure means of transportation which is not at the mercy of the transit countries.

Abu Dhabi: A submarine line is planned by Abu Dhabi Marine Areas, Ltd., owned 2/3 by British Petroleum Co. and 1/3 by Cie. Francaise des Petroles. A 20-mile submarine line will be built to tiny Das Island, where gas/oil separators, a tank farm, and a tanker loading jetty will be built.

Israel: The completion of the 257-mile crude oil pipeline system from Elat on the Gulf of Aqaba to Haifa refinery made the entire system 16 inches in diameter, with a capacity of 34,000 b/d. Addition of a new pumping station is expected to boost this to 58,000 b/d during 1961. Two more pumping stations can be added later, if needed, to raise capacity to 116,000 b/d and 150,000 b/d with each addition. A contract signed August 31, 1960 transferred control of the line to a group of international financiers from Tri-Continental Pipeline, Ltd., headed by Baron Edmond de Rothschild.

An 18-mile, 6-in. pipeline to the city of Sodom opened during 1960 from the gas find at Rash-Zohar, west of the Dead Sea. Another line is proposed to supply gas to a new power station at Ashdod Yam, on the Mediterranean, some 75 miles in length.



Iran: Completion of the Kharg Island submarine line, the longest such "pull" in the world by Collins Construction Co., has not stopped pipeline activity in the country.

Recently an agreement was signed between NIOC and Williams Bros. (Overseas) Ltd. for construction of the Shahroud-Meshed 8-in. products line. This is the second stage of the Tehran-Meshed pipeline, the first stage was completed by Williams Bros. during August.

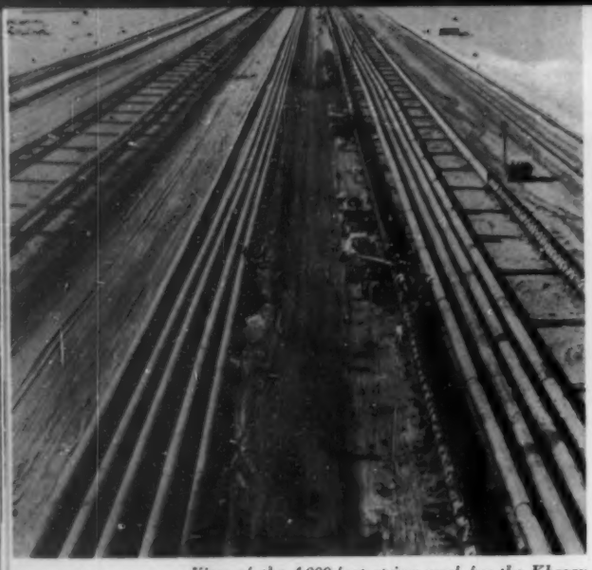
NIOC, which is the government's company, is extending its products line network to keep up with the country's very fast oil consumption increase. The 150 kilometer (90 mile) 8-in. products line from Tehran to Qazvin became operational about August 10.

In the Consortium's area, the Gach Saran-Shiraz natural gas line is going ahead and at the end of August was completed up to Marvdasht, about 45 kilometers away from Shiraz.

The Kharg submarine pipeline was completed December 17, 1959, and has since been put into operation, feeding by gravity crude oil from Gach Saran field to a modern sea terminal 25 miles offshore. The 30-in. line is the world's largest gravity line and it was laid at depths ranging up to 160 ft by International Marine Constructors, C.A. (INMARCO) and Collins Construction Co., both headed by Sammy Collins. A unique "friction transportation method" was used whereby the long strings of pipe were pulled into position by a pull barge after having been coated several times, the last coat being a 2½ inch layer of concrete.

Iraq: A looping program in the IPC pipeline system from Kirkuk to the Mediterranean will increase capacity of the field to 700,000 b/d by the end of 1960. A deepwater terminal being set up in the Persian Gulf off Fao will permit production of 440,000 b/d from Iraq's southern fields. IPC's two big fields in southern Iraq are Zubair and Rumaila. The newest loop is a 249-mile 30/32-in. section from Kirkuk to the Syrian border. It will tie into another series of loops that already extend most of the way across Syria.

Iraq Petroleum Co. awarded the contract to Turriff-Burden, Ltd., London. The firm is an associate of Turriff Construction Co., London, and O. R. Burden Construction Corp., Tulsa. A total of 217 miles of 30 and 30/32-in. line has been laid across Syria in nine separate looping projects. Two 24-in. loops of 28 and 40 miles have been added



View of the 4,000-foot string used for the Khargu Island to Ganaweh pipeline pull in Iran. Collins Construction Photo.

at the western end of the system. Final links to tanker terminals at Banias, Syria, and Tripoli, Lebanon, are under construction.

The 65-mile loop in southern Iraq will parallel an existing 24-in. line from Zubair to Fao, on the Persian Gulf.

The expansion programs in northern and southern Iraq are geared to raise the country's export capacity to 1,140,000 b/d by the end of 1961. IPC's existing system from its northern fields to the Mediterranean consists of three lines of 12, 16, and 30-in. diameter.

Early construction bids have been called for on a 10,000 mcf per day gas line from Rumaila oil field in Basrah.

Kuwait: The country's newest field, Raudhatain, has added a conservative 100,000 b/d to Kuwait's 1,500,000 b/d oil production. The new field can easily supply more than twice its initial output and will when additional power facilities are added to move crude to the south. A new 30-in 63-mile pipeline is moving stabilized crude due south from the field, skirting the western end of Kuwait Bay and then southeast to the newly constructed North Tank farm on a 375-ft elevation overlooking KOC's new North Pier. Three 40-in gravity flow lines link the tank farm and the new pier and give the new terminal a loading rate of 50,000 barrels an hour.

Gas-oil separation is carried out in three stages. Five pairs of vertical separators, relatively novel for the Middle East, are used in the first two stages. Each pair of these separators has a 25,000 b/d capacity. The final stage is carried out in two 50,000-flow tanks.

Only 16 flowlines are now in use in the incoming manifold which links 29 wells to the gathering center. In addition to the Raudhatain wells, completed wells at Sabriya, to the east and Bahrah, to the southeast, are connected with the gathering system.

The pump station to move the crude south by the 30-in. pipeline is equipped with three centrifugal pumps powered by three 900 hp gas turbines in series.

Saudi Arabia: A new line being constructed in Saudi Arabia at present is SRT-2, a loop line from Safaniya designed to increase the capacity of the line from Safaniya and Kharsaniya to Ras Tanura terminal on the Persian Gulf. Work on the SRT-2 line is progressing, with distribution of the pipe along the route completed.

Construction on the 19-mile Qatif-Ras Tanura No. 5 pipeline has been completed and the line went into service July 16.

Cathodic protection units were installed along the line, and final stabilizing of the line is now complete. Stabilization involves placing a layer of crude oil over the line to prevent the wind from blowing away the sand covering the line. The line is a part of the over-all pipeline system carrying crude oil from Abqaiq to Ras Tanura tying in with the QA lines and Qatif Junction and the T-lines near the Ras Tanura Bulk Plant.

Delivery of the 30-inch pipe to the job site on the Safaniya-Ras Tanura No. 2 pipeline has been completed and the pipe has been strung along the right-of-way. Work on the SRT-2 project is scheduled for completion Oct. 1.

The Aramco's big pipeline to the Mediterranean, Tapline, is feeling the pinch of low tanker rates. Deliveries from the Sidon, Lebanon, terminal of the big-inch pipeline from Saudi Arabia were at the lowest level in 1959 since 1956, averaging 336,394 b/d. Capacity of the 1,069-mile system to the Mediterranean is rated at 450,000 b/d. Trans-Arabian Pipeline Co. attributes a large part of lower deliveries to the world surplus of tankers and the resulting low tanker rates between the Arabian Gulf and the Mediterranean. The company operates a 754-mile section of the 30 and 31-in. line from Qaisumah, Saudi Arabia, to Sidon. Aramco operates a 315-mile section in Saudi Arabia.

Syria: According to the government, an estimated 266 million Syrian pounds will be spent on oil projects in the Syrian region under the first industrialization program which ends in 1962. Of this, 45 million will be spent on exploration and drilling and 36 million on development of the Karachuk field. A 200,000-ton refinery will be built at Qamishli near the Karachuk field—to cost nine million pounds (2,700,000 in hard currency). Three pipelines for crude and products are planned.

The first pipeline, a 13-in. 600-km crude line, will link the Karachuk fields with the new port at Tartus, passing through Homs, at which point crude will be fed into the new refinery there. This line will have an annual capacity of two million tons and, together with gathering centers and pumping stations, will cost 99 million pounds. The two 6-in. product lines, costing an estimated 18.9 million pounds, will link the Homs refinery with Aleppo via Hamah and Damascus to facilitate local distribution of refined products. Another nine million pounds will be spent for establishing new products' storage facilities in Damascus, Aleppo, Homs, Hamah, Latakia, Dair al-Zur, and Hasakah.

ASIA AND AUSTRALASIA

There are three large crude lines under construction. In Indonesia, Shell has a 40,000 b/d line under way. It will cross 161 miles and be 20 inches in diameter. Origin will be the Tanjong field in Borneo. Its destination is the Balikpapan refinery. Completion date is January 1962.

In India two large crude lines are planned and construction has begun. Both are by Oil India Private, Ltd. One line will originate at the Nahorkatiya field and go to the proposed refinery at Roonmati in Gauhati. Diameter is 16 inches, length 261 miles. The same line will be extended 459 miles. Originating near Gauhati, it will carry crude to the proposed refinery at Barauni. Completion date on both these lines is April 1962.

EUROPE

Extensive changes are underway in Western Europe's transportation system. There are several large projects underway which will carry imported crudes to refineries, both existing and planned, and demand levels have risen to the point where large pipelines are now justified. New refineries will add some 460,000 b/d of capacity by the middle of the 1960's, and extensions may add to this to make the total nearly 700,000 b/d.

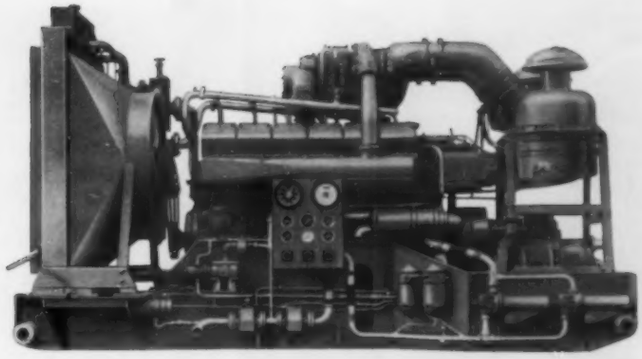
France: The principal new line building is the Lavera-Strasbourg Karlsruhe line which will be built by the Ste. du Pipe-line Sud-European, comprising 10 international companies. It will have a diameter of 70-80 centimeters (about 28-32 inches) and will carry annually some 200,000 b/d. This figure represents initial capacity, and it can later be raised to about 600,000 b/d. The line will have a length of 760 miles. It will be in service by the end of 1962.

Germany: Two large lines are new additions to the scene, both of them recently completed. A 28-inch line went into service in January of 1960, from Wilhelmshaven, near Cologne, to Wesseling, some 385 miles. It will carry about 180,000 b/d initially, rising to a maximum capacity of 440,000 b/d. Another line originates in Rotterdam. It goes to Venlo-Wesseling-Wesel for some 290 miles, with a diameter of 25 inches. Initial capacity is 170,000 b/d, rising to a maximum capacity of 400,000 b/d. This line has been in service since July. It is owned 40% by Shell, 20% by Caltex, and 40% by Gelsenberg/Mobil Oil.

Italy: The government's oil entity, ENI, has proposed two new crude pipelines. One would run Genoa-Northern Italy-Aigle, in Switzerland, some 420 miles. Diameter would be 25-26 inches and ultimate capacity 240,000 b/d. Completion date will be end-1961.

Oleodotti Internazionali, ENI's pipeline company for the Genoa-Aigle pipeline, has plans to extend the line to Munich, 450 miles further. Capacity would be around 100,000 b/d. The final completion date is not known. END

A range of engines for all requirements



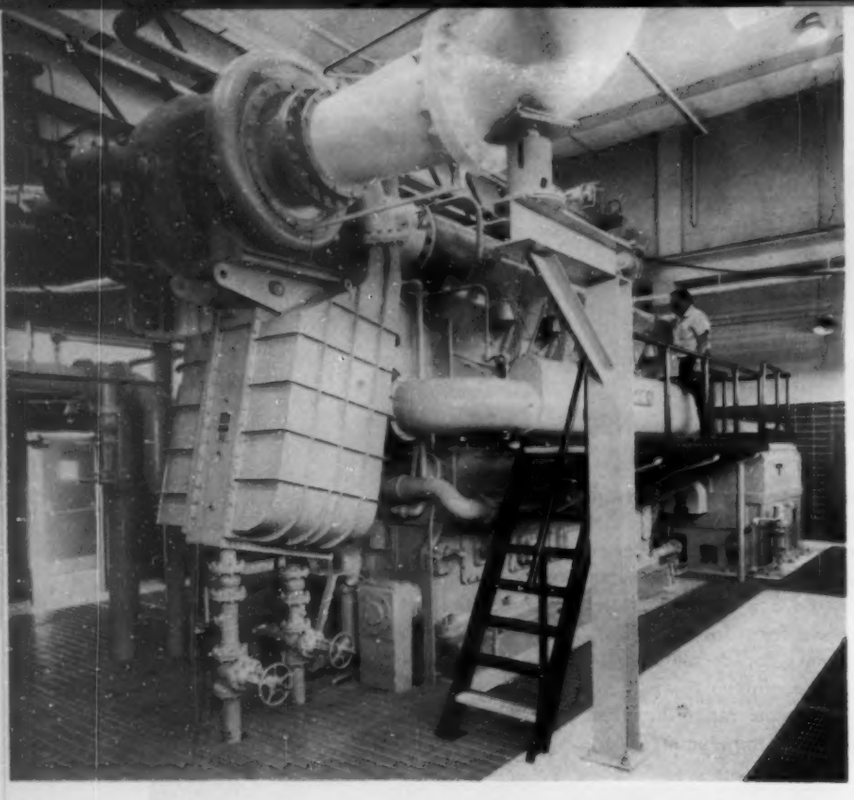
079 MAe

Mercedes-Benz Diesel engines, in common with all the products of Daimler-Benz, are world-famed for their high performance, economy, robust construction and dependability. They have further advantages which are of particular importance for drilling operations. They have a large overload reserve, they are completely equipped for work on drill sites and they comply with the international safety regulations. 34 different Mercedes-Benz Diesel engines ranging from 20 to over thousand PS are available. This wide range includes the right engines to meet the specific requirements for drilling operations.

Types and Performance Data Type	Cooling	No. of cylinders Arrangement	Output PS (DIN)	Speedrange R. P. M.	Cyl. Bore ins.	Stroke ins.	Piston displacement cu. ins.	Weight approx. lbs.
M 202 B	W	2/S	35 – 55	750 – 1200	5 1/2	8 1/4	394.8	1665
M 203 B	W	3/S	54 – 90	750 – 1200	5 1/2	8 1/4	591.9	2150
M 204 B	W	4/S	72 – 120	750 – 1200	5 1/2	8 1/4	789.0	2715
OM 636	W	4/S	17 – 35	1500 – 3000	2 15/16	3 15/16	107.8	495
OM 312	W	6/S	47 – 77	1500 – 2400	3 9/16	4 3/4	279.5	784
OM 321	W	6/S	55 – 94	1500 – 2600	3 3/4	4 3/4	311.2	784
OM 315	W	6/S	80 – 124	1200 – 1800	4 7/16	5 1/2	505.0	1700
OM 326	W	6/S	97 – 155	1200 – 1800	5 3/64	5 1/2	660.0	1720
MB 851	W	1/S	9 – 20	1000 – 2000	4 1/2	5 1/2	88.8	562
MB 861	L	1/S	9 – 20	1000 – 2000	4 1/2	5 1/2	88.8	662
MB 852	W	2/S	18 – 40	1000 – 2000	4 1/2	5 1/2	176.9	915
MB 862	L	2/S	18 – 40	1000 – 2000	4 1/2	5 1/2	176.9	915
MB 853	W	3/S	27 – 60	1000 – 2000	4 1/2	5 1/2	266	1122
MB 863	L	3/S	27 – 60	1000 – 2000	4 1/2	5 1/2	266	1122
MB 854	W	4/V	36 – 80	1000 – 2000	4 1/2	5 1/2	354.4	1245
MB 864	L	4/V	36 – 80	1000 – 2000	4 1/2	5 1/2	354.4	1245
MB 846 A	W	6/S	114 – 250	750 – 1500	5 7/8	7 1/2	1230.2	3860
MB 846 B	W	6/Li	114 – 250	750 – 1500	5 7/8	7 1/2	1230.2	3970
MB 846 Ab ▽	W	6/S	148 – 320	750 – 1500	5 7/8	7 1/2	1230.2	4080
MB 846 Ad ▼	W	6/S	148 – 320	750 – 1500	5 7/8	7 1/2	1230.2	4200
MB 846 Bb ▽	W	6/Li	148 – 320	750 – 1500	5 7/8	7 1/2	1230.2	4200
MB 836 B	W	6/S	240 – 375	1000 – 1500	6 7/8	8 1/16	1806.3	4380
MB 836 Bb ▽	W	6/S	320 – 525	1000 – 1500	6 7/8	8 7/16	1806.3	4830
MB 836 Db ▼	W	6/S	370 – 650	1000 – 1500	6 7/8	8 7/16	1806.3	5050
MB 820 B	W	12/V	460 – 750	1000 – 1500	6 7/8	8 7/16	3612.6	6180
MB 820 Bb ▽	W	12/V	640 – 1100	1000 – 1500	6 7/8	8 7/16	3612.6	6900
MB 820 Db ▼	W	12/V	770 – 1350	1000 – 1500	6 7/8	8 7/16	3612.6	7240
MB 837 A	W	8/V	165 – 440	1000 – 2000	6 1/2	6 7/8	1825	2940
MB 837 Aa ▽ ▽	W	8/V	215 – 550	1000 – 2000	6 1/2	6 7/8	1825	3020
MB 835 Ab ▽	W	12/V	840 – 1450	1000 – 1500	7 1/2	9 1/2	4773	8157
MB 835 Bb ▼	W	12/V	1015 – 1780	1000 – 1500	7 1/2	9 1/2	4773	8597
MB 839 Ab ▽	W	16/V	1120 – 2000	1000 – 1500	7 1/2	9 1/16	6380	11020
MB 839 Bb ▼	W	16/V	1350 – 2400	1000 – 1500	7 1/2	9 1/16	6380	11450
MB 518 B ▼ ▼	W	20/V	3000	1720	7 5/16	9 3/16	8201.5	10550

Note:
W = water cooling · L = air cooling
Li = horizontal · S = vertical
V = vee type · ▽ = with exhaust-turbo-supercharging · ▼ = with exhaust-turbo-supercharging and boost intercooling · ▽ ▽ = with mechanical supercharging
▼ ▼ = with mechanical supercharging and boost intercooling

MERCEDES-BENZ DIESEL



Installation at Columbia Gulf Transmission Co.'s Hampshire, Tenn., booster station of a two-cycle Clark Bros. gas engine driving a centrifugal pipeline compressor.

First two-cycle engine driven centrifugal compressor

A NEW, fully-automated compressor station, utilizing the first installation of a two-cycle gas engine-driven centrifugal compressor on a natural gas pipeline, has been meeting all anticipated performance ratings since its start-up in June.

The station, at Hampshire, Tenn., on Columbia Gulf Transmission Co.'s automated natural gas line, is designed for completely unattended operation with remote control from the company's control center in Nashville, Tenn.

It is the result of an agreement made in December, 1959, between Columbia Gulf and Clark Bros. Co., one of the Dresser Industries, to install a Clark TPV-10 two-cycle engine-driven centrifugal compressor to determine the economics and feasability of such an installation with regard to (1) the merits of a two-cycle compared with a four-cycle engine driving a centrifugal, and (2) operation of a non-attended two-cycle engine-driven centrifugal compressor in conjunction with existing engine-driven reciprocating compressors at a common compressor station site.

The general layout and engineering design philosophy to be followed in the installation was developed jointly by Columbia Gulf, Clark Bros., and Gulf Interstate Co. The detailed design and engineering of the station was performed by Gulf Interstate commencing in January, 1959. The station automatic control equipment was designed by Columbia Gulf. The construction contract was awarded to Mid-Valley Utility Constructors in mid 1959; the engine placed in service on June 1960. A minimum of operational difficulties during start-up reflected the correctness of basic design and the high quality of workmanship.

The basic design concept of this station is one of low cost of service consistent with maximum availability and dependability. The engine-compressor unit is completely self-sustaining, all required auxiliaries being driven by direct power take-offs from the engine itself, and no dependence on secondary auxiliary drivers. Engine gear, compressor, and other station components were selected on the basis of absolute minimum maintenance cost. The station is fully automated, and the engine fuel consumption has been reduced to the lowest point consistent with dependable, low maintenance operation.

Station building design is similar to the original concept used in existing Columbia Gulf engine-driven centrifugal stations. This basic approach is one of maximum safety and minimum maintenance and includes such features as (1) all high-pressure gas outside the engine room, (2) extensive use of pre-cast concrete columns and beams, (3) concrete firewall separating engine room from compressor and high-pressure piping, and (4) automatic fire protection system. The Hampshire station also utilizes aluminum sandwich walls with perforated inside panels for sound attenuation and a row of windows for increased interior lighting.

The compressor has also been completely enclosed to facilitate maintenance in inclement weather. All control and auxiliary equipment is housed in an adjoining space, divided into a control room and an auxiliary room.

Automation: Operational control of this station will be from the central control point at Nashville, where the dispatcher will be able to monitor the required operating information he will receive. All operational commands and displayed information is transmitted by a digital pulse system over leased lines. In the event of communications failure, the Hampshire station will continue in automatic operation satisfying the last discharge pressure set-point command received. The engine and station are fully protected with emergency shutdowns at all times.

The adjoining reciprocating compressor station is presently in attended semi-automatic operation. Columbia Gulf's five reciprocating stations are now being automated for remote unattended operation.

All controls will be self-contained at the station, the discharge pressure order being the only command from Nashville. The local station automatic control equipment will determine the number and speed of engines required to maintain the discharge pressure order. The Clark TPV-10 engine driven centrifugal unit will be generally operated at rated load, the reciprocating units taking the load swing to maintain the ordered discharge pressure. The centrifugal unit will operate over its design speed range of 270 to 360 rpm as pipeline flow varies.

The heart of the Hampshire centrifugal station is the Clark TPV-10 engine. The engine now installed at Hampshire was first put on the test block in Olean, N. Y., in February of 1959 and run for approximately seven months before shipment to Hampshire.

The ten-cylinder engine is the smallest of a line which includes a 12- and 16-cylinder engine as well. The twelve cylinder engine is rated at 4,800 bhp and the sixteen cylinder engine at 6,400 bhp.

Basically, the TPV engine is an adaptation of the TLA line (The first TLA engines were also installed at Hampshire in

(*Continued on page 70*)

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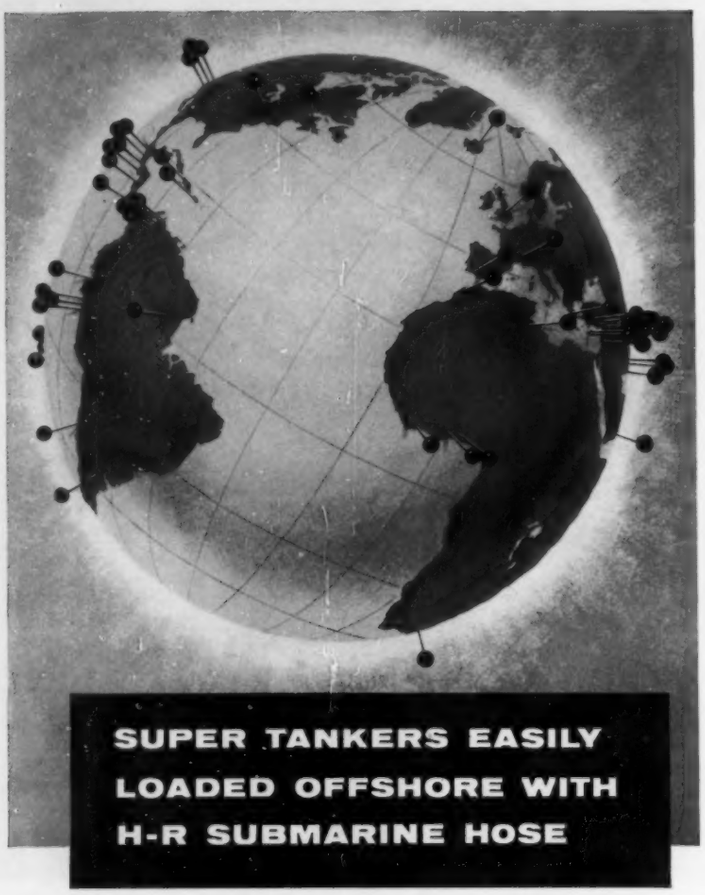

Add Riverhead, Long Island, to the long list of ports where Hewitt-Robins submarine hose meets tankers at sea! Already on steady duty in such waters as the Eastern Mediterranean, Pacific Ocean, and Arabian Gulf, H-R submarine hose enables tankers to load or discharge through underwater pipelines connected to storage tanks ashore.

The Riverhead pipeline is 7,200 feet long. The hose itself (the first East Coast installation) is 175 feet long. It is reinforced with multiple layers of heavy fabric and steel wire, and can take an end-to-end pull well in excess of 115,000 pounds. It withstands high internal pressures from ships' pumps and the external pressure of a 67-foot depth, and resists kinking and flexing action during rough water usage.

H-R submarine hose resists both coral abrasion and rot, and has given over 10 years of continuous service in installations abroad. It is available in sizes up to and including 16" internal diameter. For information or service, contact your local H-R representative, or Hewitt-Robins, Stamford, Connecticut. Ask for Bulletin 10-21.

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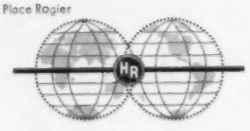


First Two-Cycle Engine Driven Centrifugal Compressor

(*Continued from page 68*)

1952), the principal modifications being the Vee configuration, higher power cylinder compression ratio for higher thermal efficiency, and a larger diameter crankshaft to handle the loading characteristic to rotating equipment. Although the detailed testing has not been completed at this time, it is anticipated that the fuel consumption will be in the range of 6,600 btu per bhph.

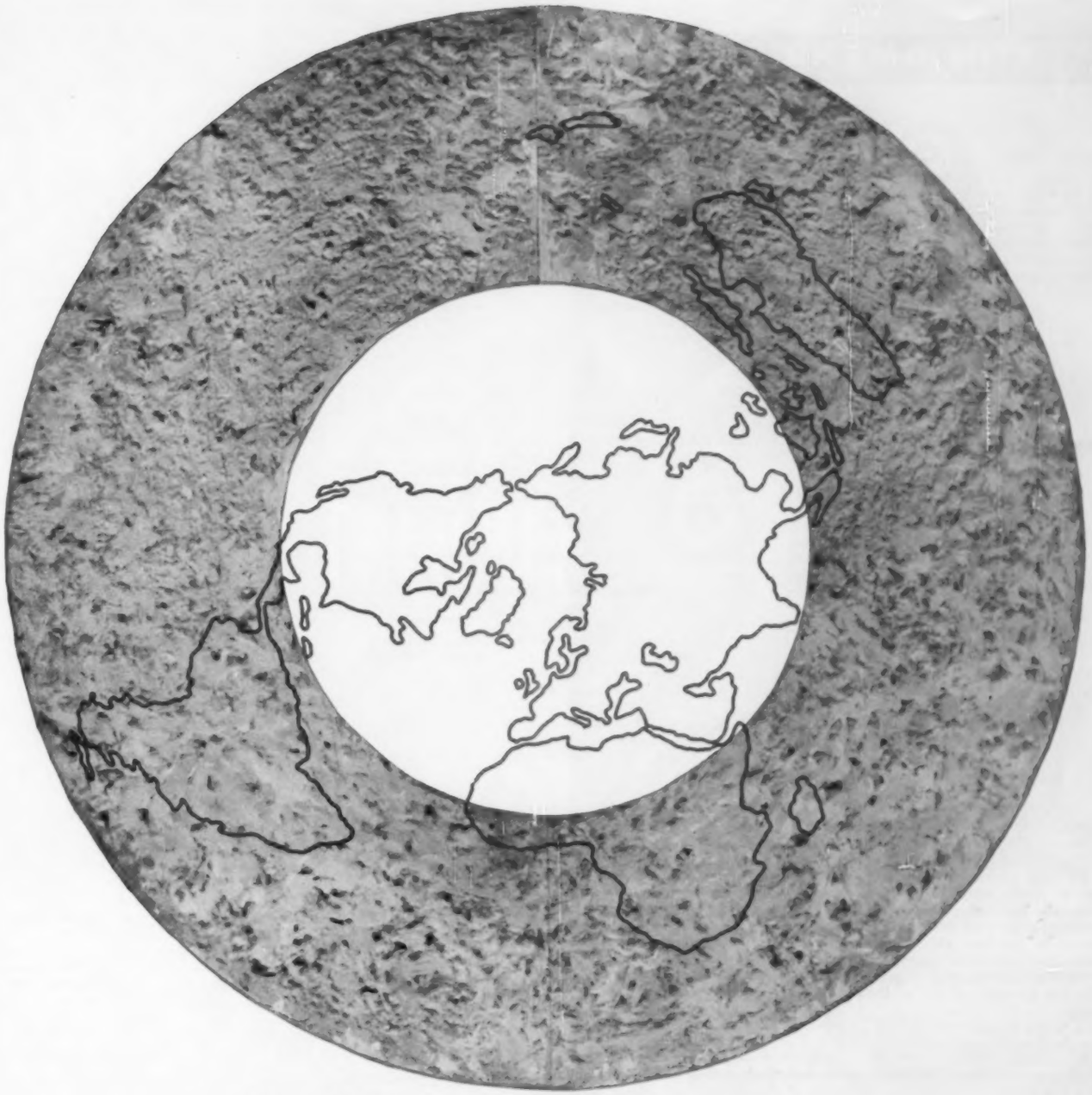
The basic gear design incorporates an "In Line-Locked Gear" train. The input and output shafts are on the same centerline. The gear is rated at 4,800 hb continuous at 360 rpm input speed. The gear ratio is 15.3:1.

The gearing is double helical, hobbed after heat treatment and accurately balanced. The lubrication system is common with the engine having equalizing lines between gear and engine. Both intermediate assemblies are of quill shaft design and each are equipped with an airflex coupling. These two features are very effective in dampening torsional peaks.

Centrifugal Compressor. The pipeline booster is the standard 24 x 24 low ratio, high volume pipeline compressor. It has a large exterior casing, a removable volute (internal assembly) and removable guide vanes. The pitch of the guide vanes can be varied to maintain peak efficiency over a wide range of operating conditions. At maximum engine speed the compressor will be spinning at 5,500 rpm. The compressor design point is at 83% adiabatic efficiency and a volume of 850 mmcf/d. The compressor was designed to handle future pipeline volumes and at the present volume the adiabatic efficiency is in the vicinity of 75% to 80%.

Since the unit first went on the line June 10, 1960, it has logged approximately 1,500 hrs of operation. Torsiograph readings have been taken, verifying that the designed operating range of 270 to 360 rpm is free of critical vibration. The unit has been operated over this complete range of bhp loads of from 2,100 at minimum speed to as high as 4,600. Although a final evaluation is slightly premature, all indications are that this station satisfies all initial design requirements; that is, that the two-cycle turbocharged engine is entirely satisfactory as a variable speed prime mover for equipment and that it will accomplish reductions in cost of service on future compressor stations. END

The preceding material is based primarily on a technical article on this installation, by Corder Reynolds, project engineer, Columbia Gulf Transmission Co., and John Murphy, assistant marketing manager, Reciprocating Products Division, Clark Bros. Co.



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TA3612

LATIN AMERICAN OIL NEWS

ARGENTINA—Crude production climbed to 4,307,671 cubic meters in the first half of 1960, a gain of 26.6%. YPF production (including that of contracted companies) climbed 30.4% to 4,023,758 cubic meters. Private-company production dropped 15% to 283,913 cubic meters. Crude imports in the same period were 2,156,488 cubic meters, a drop of 25.9% from a year earlier. This brought a saving in foreign exchange of $18,489,302 (USA).

ARGENTINA—Argentina's State oil agency YPF has invited bids from international oil companies, to be submitted by October 7, for areas hitherto unexplored and on basically the same terms as in contracts previously negotiated with private companies. Bids were to indicate size of area, expected duration of contract, work plan, and proposed investment. Oil is for delivery to YPF at international prices.

ARGENTINA—Of Pan America's 180 wells in eight different fields in Argentina at mid-year 1960, 155 were producing; 25 were temporarily abandoned or dry holes (10 to be deepened or tested further). A deep test in the Anticlinal Grande field, which had gone to 8,455 ft, was completed in a shallow pay section during January. Pan Am had two wildcat discoveries during the period—one for 596 b/d, the other for 534 b/d. Nine rigs were operating (four completed). Operating full-time was one contract seismic crew and one surface geological crew.

ARGENTINA—White Eagle International Inc. has signed a 20-year agreement to initiate secondary recovery in the Argentine oil properties of Astra Cia. Argentina de Petroleo SA—the contract covering 14,905 acres in Comodoro Rivadavia which has been producing since 1917. With engineering studies completed, White Eagle is ready to begin an experimental pilot flood.

ARGENTINA—YPF has announced oil imports in the first five months of 1960 totaled 2,280,654 cubic meters at a c.i.f. cost of $48,562,639, or average price of $21.29 per cubic meter. This compares with a reported cost of crude extracted by Pan American in the Comodoro Rivadavia zone of $10 per cubic meter; delivered to the YPF refinery at La Plata the cost is said to be less than $12. The Loeb Rhodes Bank (which produces under contract for YPF in Mendoza) delivers rail-transported crude from Mendoza to the San Lorenzo refinery at about $13 per cubic meter.

According to the president of YPF, crude production during the first six months of 1960 totaled 4,002,623 cubic meters, of which 3,343,339 represents YPF production, and 659,284 by companies producing under contract to YPF.

ARGENTINA—The Chicago Bridge and Iron Co. has contracted to build and assemble the terminal tanks for a pipeline to be constructed by Esso Argentina for the Argentine state-owned oil monopoly.

The job will cost $32 million. It is expected to be completed in July, 1961.

BARBADOS—The Barbados plant in which Mobil International recently acquired an interest, located at Bridgetown, has been expanded to a capacity of 1,000 b/d. Products will be marketed under the Mobil name.

BRAZIL—Petrobras, Brazil's government agency, has estimated Brazilian oil consumption for 1960 at 250,000 b/d. The breakdown (in barrels per day) is: avgas 8,700; motor gasoline 74,000; kerosine 11,500; LPGas 11,500; diesel fuel 58,000; fuel oil 82,500; lubricants 3,800.

BRAZIL—Crude imports in the first quarter of 1960 were 9,309,350 bbl, and exports 2,020,707 bbl, or net imports of 7,288,643 bbl.

BRAZIL—Corrected official figures for Brazil's production (barrels per day) are: January 75,596; February 74,416; March 76,264; June (official) 80,000. Rigs operating in June totaled 62. Footage drilled January-April totaled 349,463 ft; 75 wells were completed, of which 48 are producers (1959 figures for comparable period: 249,712 ft; 68 completions—36 producers).

Head of Petrobras has denied operations in Amazon region are to be abandoned. Cost of such operations amounted to 2,000 million cruzeiros in 1959—to reach 2,500 million in 1960. Tests of well AM-6-AM indicate encouraging signs of commercial oil in the area, where wildcats No. 8 and 9 are now drilling.

Imports of refined products dropped to 75,383 b/d in 1959 from 86,873 b/d in 1958. Imports of lubricants, diesel oil, and LPGas increased to 3,532, 25,683, and 2,351 b/d, respectively, from 2,989, 22,656, and 1,791 b/d in 1958. Imports of motor gasoline, kerosine, and fuel oil declined to 9,619, 4,380, and 22,193 b/d, respectively, from 15,766, 6,617, and 29,901 b/d in 1958.

The average monthly cost of a geological team in the Reconcavo (Bahia) is 423,000 cruzeiros; of a geological team, 4,300,000 cruzeiros.

CUBA—Diplomats hear that Cuba faces a fuel-oil shortage. Russian crude produces lots of gasoline, but little residual oil.

MEXICO—Total wells drilled during 1959 was 441 against a target of 477, and against 379 in 1958. Some 278 found oil and 20 gas, while 143 were dry. In 1958, 284 found oil or gas and 95 were dry. Exploratory wells totaled 133 against 76 in 1958, and 34 found oil and eight gas, while 91 were dry. Average depth of the wells was 7,035 ft against 6,958 ft in 1958.

Production of crude oil, distilled, and natural gasoline rose by 5.4% to 289,749 b/d. By zones, there were increases for the Northeast District, North District, Tehuantepec and Tabasco, but decreases for South District, New Golden Lane, Poza Rica, and Papaloapan basin.

Natural-gas production was 329,363 million cubic feet, a rise of 25% over 1958, compared with a 1957-to-1958 rise of 62%. Exports to the USA rose 11.4% to 1,517,323,072 cubic meters.

Crude runs to stills in 1959 came to 266,762 b/d, a gain of 8.9% from 1958. Most of the increase was in lighter crudes; for more gasoline, kerosine, naphtha, distillate, and LPGas. LPG output rose 59%, and lube oil output by 14.9%, and a start was made on jet-fuel production with output of 66,030 bbl.

Domestic consumption was 270,329 bbl in 1959, a gain of 2.5%, against gain 3.8% and 5.7% in the two prior years.

Exports of crude, all USA, came to 111,627 bbl and of products, most of it to the USA, came to 13,182,608 bbl.

Imports of crude came to 20,996, bbl, and of products to 8,364,691 bbl, a total for both of 13,400,000 in 1958. Almost all of it came from the USA.

NETHERLANDS WEST INDIES—A subsidiary of Raymond Internationa, New York, has been awarded a contract for construction of one of the world's largest and most-up-to-date oil ports. With work to begin in Aruba, NWI, in October, a $4 million 900-foot-long jetty should be completed by mid-1961.

PERU—Latest offshore well in Peru by Cities Service and Richfield was completed under 132 ft of water. It tested 200 b/d on choke, with the oil flowing through 6,200 ft of 3-in. submarine line to storage facilities on shore.

PERU—Peruvian Pacific Petroleum Co. found oil off the coast in its Humboldt 3-2 at 950 ft. Production was 350 b/d of 37-gravity oil at a gas pressure of 200 psi. The well is producing by use of a submarine well head and aluminum piping to the shore. The drilling barge "Rincon" and its auxiliary vessel "El Barquero" have been leased to Belco Petroleum Co. for drilling two test wells in the Belco continental-shelf concession upon completion of Humboldt 3-2.

TRINIDAD—Trinidad during 1959 produced 40,918,786 bbl of crude, or about 112,107 b/d. Wells drilled during the year totalled 278.

VENEZUELA—Venezuela has forbidden two oil companies (not identified) to sell oil in world markets at a discount. Petroleum minister Juan Pablo Perez said Venezuela will warn each market that turns to the Soviet Union for oil that Venezuela will not supply it when normal conditions return. He said such was the case with Cuba, which is buying Russian crude. The Venezuelan order is a departure from its previous policy of "persuading" companies to refrain from sales of crude at steep discounts which at times have ranged from 75¢ to $1.00 per barrel.

VENEZUELA—Venezuela's oil ministry has reported one of the country's most important discoveries in Venezuelan Sun et al.'s SVS-41 well in Block 1, Lake Maracaibo, which registered 1,588 ft of net pay thickness, the thickest pay sand thus far in the country. Oil was found in the "B" and "C" sands (Eocene) and the Santa Barbara sands (Niocene). In Sun's new Maracaibo oil pool, the well is projected to total 15,100 ft.

VENEZUELA—Preliminary figures of Venezuela's Ministry of Mines & Hydrocarbons estimate 69% of Venezuelan oil revenues in 1959 went to the government, leaving only 31% for the oil operators. The profits split in 1958 was 65-36, when income taxes were increased sharply. During the 11 previous years the government's take ranged between 52% and 60%, excluding payments for concessions.

VENEZUELA—Official government figures indicate Venezuela's oil production in the first six months of 1960 averaged 2,849,400 b/d, slightly under the 2,852,000 b/d for the comparable 1959 period.

VENEZUELA—Venezuelan Sun reports its significant Block 1 Lake Maracaibo discovery, which has recorded the thickest pay sand thus far in Venezuela, encountered 1,797 ft of productive oil sand and extends the former productive limits of the field by 2/3 mile to the south. On initial production test, the well produced 7,500 b/d of 30-gravity oil through a ¾-in. choke. The well is located on a concession jointly held by Venezuelan Sun, Venezuelan Atlantic Refining, and Texaco-Seaboard, Inc.

VENEZUELA—Crude production in the first half of this year was 2,849,400 b/d, a drop of 0.12% from a year earlier. Gains were shown by Mene Grande, up 50,900 b/d; by Venezuelan Sun Oil Co., up 45,300 b/d; Phillips Petroleum Co., up 45,200 b/d; San Jacinto Venezuelana, up 10,800 b/d; and Mobil Oil Co. of Venezuela, up 10,500 b/d. Decreases were shown by Shell, down 119,700 b/d; and Creole Petroleum Corp., down 69,600 b/d.

Crude production last year was 160,803,117 cubic meters, a rise of 6.38% from 1958. Refinery runs were 47,819,000 cubic meters, a gain of 13%. Exports of crude and products were 149,171,000 cubic meters, a gain of 5%. The USA continued as the chief export market, taking 64,086,918 cubic meters of crude and products, a gain of 1.7%, some 43.9% of total exports. Canada was next.

Wells completed in 1959 came to 707—of which 552 were oil producers; eight gas producers; 137 dry; nine for gas injection, and one for air injection. Some 40 wells were abandoned; four were redrilled, and 61 were still being drilled. Total meters drilled was 1,856,655, some 830,000 meters less than in 1958. Proved oil reserves at the start of this year were 2,721 million cubic meters, an increase; and gas reserves were 945,766 million cubic meters, a slight gain. Observers foresee a deteriorating position in world oil supply without steps to improve the competitive price margin and to give industry incentives to explore.

VENEZUELA—Venezuela has been formally invited to send a delegate to the Arab League Nation's Second Oil Congress scheduled to be held in Beirut, Lebanon, in October. The delegate, however, will have no voice in the proceedings, and will go merely as an observer.

VENEZUELA—To avert a further drop in her slumping economy, Venezuela has begun a search for financial help to the tune of $300 million from foreign oil companies and public and private international financial organizations—the second time in 18 months the government has turned to international sources for assistance. Though oil price competition in world markets is an important cause, it is not the only reason Venezuela has suffered a net loss of almost $800 million in foreign currency and gold since January 1958. Oil traditionally produced 80% of Venezuela's foreign income and a major share of her tax income.

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by William C. Uhl
Processing Editor

Highlights of the month—progress reported in fuel cell research though commercial success is still in far future; economics dictate reduction in oil-from-coal work in UK; diesel fuel use rising in commercial type vehicles due to lower fuel consumption rates

The conversion of fuel directly to electricity by means of a fuel cell is probably still a long way from commercial success. However, the value of a practical fuel cell is so great that many organizations are continuing intensive research in the field; the energy lost as waste heat is only 20 to 30% as compared to the 60 to 85% lost in a steam turbine or an automotive type engine.

Among the major problems has been finding a way to use conventional fuels and increasing the power output of the devices.

The most recent advance is one announced by "Shell" Research Ltd., a low temperature fuel cell that can generate from three to five times more power per unit volume than other similar cells under present development.

Shell's interest in the fuel cell, according to Dr. C. G. Williams, director and general manager of the research firm, "stems from the fact that the oil industry is a supplier of fuels and no one has yet decided just what kind of fuel will best suit the fuel cell of the future." The work was carried out at Shell's Research Centre at Thornton, in Cheshire, England.

The high output of the new cell results from fundamental studies made at Thornton of electrodes. This has led to the development of inexpensive and easily fabricated electrodes which are highly active.

Development work has been carried out using hydrogen as the fuel, but the cell has demonstrated its ability to use other fuels and work will be continued in that direction.

The cell can operate with either alkaline or acid electrolytes. When run on hydrogen and oxygen at a pressure of 3 psi, current densities of 70 amp/sq ft can readily be obtained with both types of electrolyte at room temperature. If air is substituted for oxygen, there is little loss in performance. As the cell warms up to 60 C, the output is doubled. Power per cu ft is 3 to 5 kilowatts.

The acid cell has a major advantage, Dr. Williams said, because the electrolyte is free from troubles due to carbon dioxide. Present in air as well as in gases derived from hydrocarbon fuels, this gas destroys the activity of the alkaline electrolytes.

"Shell" has constructed multiple fuel cells with up to six cells per inch and believes that units having a power-to-weight ratio of 50 watt/lb are realizable. The company does not, however, plan any larger units as it is considered too early to predict the lines along which fuel cells will be developed.

Economics have shifted the prospects for making oil from coal farther into the future in the United Kingdom. The Committee on Coal Derivatives considers prospects so remote that it has recommended that, when the present work is completed, no further technological work specifically directed towards the oil-from-coal process should be undertaken.

This committee was established by the British Minister of Power in April, 1959, to inquire into research and development work on the processing of coal to produce chemicals, gas for fuel purposes, and for chemical synthesis and various types of hydrocarbon oils.

A highly detailed 80-page report discusses the subject in all its aspects. In broad terms, the committee's studies showed the capital cost of a project designed to process 1 million tons/yr of coal, and to produce about 180,000 tons of oil plus a substantial quantity of town gas would be between £25 million and £35 million. Revenue from product sales would be about £6 million, while operating costs—including depreciation—would be about £7 million. The result would be a substantial deficit before allowing for any return on the very heavy investment.

For oil synthesis to be economic, the cost of the synthesis gas—the major part of the total cost—would have to be reduced, and none of the evidence submitted led the committee to believe that the chances of economic success in effecting this reduction are such as to justify the spending of £10 million to £20 million necessary to develop the necessary technology.

On the basis of the present subsidy (ls.3d./imp gal) for home-produced oils, a 1 million ton/yr plant would get about £3 million credit, but its output would be only 1% of the present national consumption of distillate oil. This means that to produce a significant proportion of oil requirements by synthesis from coal would require a very large subsidy.

Coal was also examined as a raw material for aliphatic organic chemicals, and the conclusion reached that in the immediate future the cheapest method of making pure hydrogen for chemical purposes is likely to be the steam reforming of light naphtha, and that by the late 1960's the synthesis gas requirements are likely to be doubled.

An experimental fuel cell of advanced type under study at Shell's Thornton Research laboratories. Dr. D. P. Gregory samples the electrolyte.

Greater use of diesel fuels in automobiles in commercial fleets—company cars, taxicabs, and the like—is foreseen by two representatives of British diesel manufacturers in talks before a recent meeting of the Society of Automotive Engineers in San Francisco.

The advantages of the diesel engine are most significant to vehicles used by taxi and delivery truck companies, and in large fleets of conventional cars piling up large annual mileages, said J. H. Pitchford, Ricardo & Co. Ltd. This means operating conditions fuel situation should be given more attention. Any wide-spread swing to the diesel in the USA could lead to a severe fuel shortage.

Some improvements are needed in the fuels also, from the viewpoint of the engine manufacturer. Fuels should have better smoke limits, reduced combustion noise, improved volatility, and lower ignition temperatures. Dawson urged the oil industry to carry on more research on diesel fuel improvements.

What's New in Processing Plants

Home Oil Co. Ltd. now has plans to double the capacity of the recently completed 75 mmcf/d gas plant at Carstairs, Alberta, which it operates for a group of 12 companies.

• • •

A new Salvadorean associate of the Royal Dutch/Shell Group has been organized to construct, own, and operate a new $9 million, 10,000 b/d refinery at Acajutla, El Salvador. Processing equipment will include a crude still, catalytic reformer, and hydrogenation treater. Fluor-Schuitvlot N.V., Haarlem, Netherlands, has the construction contact.

• • •

which include frequent stopping and starting and a light mean load factor, as well as large annual mileages.

Although the initial cost of a diesel powered car will probably always be higher than that of a gasoline car, it is today only 8 to 15% higher. This disadvantage is more than offset by the lower fuel consumption costs for the diesel, Pitchford said. A test proving this out is that in London, where virtually all taxicabs are diesels, there has been an 85 to 90% increase in fuel mileage. On the basis of 20,000 miles/yr, and either fuel at 60¢/gal, fuel costs for the gasoline taxi come to about $750 as contrasted to $400 for the diesel cab.

A diesel cab's initial cost is about $280 higher than the gasoline taxi. However, annual savings by use of the diesel came to an estimated $305, including such factors as fuel consumption, depreciation, tires, battery, lubrication, and maintenance services (some of which are higher for the diesel than for the gasoline engine).

J. G. Dawson, F. Perkins Ltd., agreed with Pitchford in principle, and went on to point out that the

Esso Standard Oil S.A. contemplates an $8 million, 10,000 b/d refinery in El Salvador, and has taken an option on property at Acajutla, adjoining that purchased by Shell for its new plant.

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Standard Oil Co. (Indiana) will complete a new 37,000 b/d crude still at Casper, Wyo., in September, 1961, replacing existing but obsolete facilities, including a crude still, thermal cracker, coke stills and some tankage.

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Philippine Oil Refinery Corp. has signed contracts with a number of French and USA companies to participate in the construction of a 10,000 b/d refinery at an undisclosed site, with completion planned by 1962. Companies include Cie Industrielle et Agricole de Vente a l'Etranger; Constructiones Metallique de Provence; Soc. de Ateliers et Chantiers de la Seine Maritime; Procon, Inc.; and Gulf Oil Corp.

• • •

(Continued on page 76)

Artists Sketch of 605,000-BBL Tank Under Construction for Aminol

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CB&I is building the world's largest floating roof tank for American Independent Oil Company, in Mena Abdulla, Kuwait, Arabian Gulf. The tank—to be constructed by Chicago Bridge Limited—will measure 260 ft. in diameter and 64 ft. in height. It's a task even Aladdin and the mystic genie of the lamp would have considered most difficult. No problem, however, for CB&I's world wide *Coordinated Services* in engineering, fabrication and erection.

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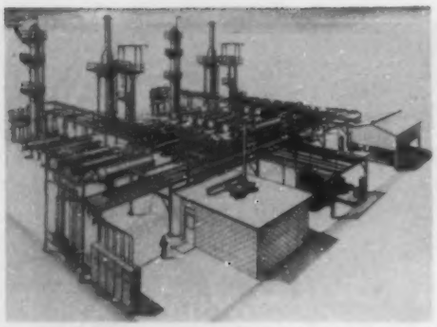

New "Gulfinishing" process unit for lube oils to be built at Gulf's Port Arthur, Texas, refinery.

Gulf Oil Corp. has awarded Bechtel Corp. the contract to build a 13,000 b/d lube unit at its Port Arthur, Texas, refinery, utilizing the company's newly developed "Gulfinishing" process, a hydrogenation technique employing a new Gulf catalyst. It will be the first unit of its type.

• • •

New Zealand is going ahead with construction of its first refinery, a 40,000 b/d plant, at an undisclosed site. Originally, the refinery was to be operated, and 60% owned, by Shell, with N.Z. investors holding the remaining 40%. Now it is proposed that all marketers in the country will be interested, both financially and operationally, in the project. This includes Shell, BP, Caltex, Europa, Stanvac, and Atlantic Union (a Stanvac subsidiary).

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The Iraq government's Board of Oil Affairs has indicated plans for a $56 million, 40,000 b/d refinery at Basra, to be completed within five years, and operate on crude from Basrah Petroleum Co.

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Phillips Petroleum Co. will build and operate a 45 mmcf/d natural gasoline plant near Abbeville, La., with completion expected in December. Owners will include Phillips, Tidewater, Pan American, and a group of individuals.

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Gulf Oil Corp. is reportedly considering a refinery in Denmark near Ebeltoft.

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The Indian government plans a third refinery, one of 10,000 to 20,000 b/d capacity in the Cambay region of Bombay.

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Refinery capacity increases planned for completion by 1965 by Egyptian government will add 86% to total capacity, as part of overall expenditure of some $230 million in next five years on all phases of petroleum. Alexandria refinery will be raised to 24,000 b/d from its present 4,000 b/d (as reported previously), and Suez plant will go to 44,000 b/d from its present 24,000 b/d. Technoexport, a Czechoslovakian firm, will carry out the expansion programs.

• • •

Odessa Natural Gasoline Co. and Warren Petroleum Corp. plan a new 20 mmcf/d natural gasoline plant in Midland County, Texas. Plan is to ship residue gas to petrochemical plants in Odessa via a 20-mile, 6-in. pipeline.

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The recently announced $15 million refinery to be built near Lima, Peru, will be 12,000 b/d. President of Refineria Conchan California S.A., organized to build the plant, is Dr. Mariano Prado, a nephew of Dr. Manuel Prado, president of Peru.

• • •

Ashland Oil & Refining Co. has awarded a contract to Badger Mfg. Co. for a 32,000 b/d vacuum distillation unit at Catlettsburg, Ky., scheduled for completion in the spring of 1961, and to replace three smaller vacuum stills.

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Ohio Oil Co. plans a 25,000 b/d refinery in Spain to refine Libyan oil, provided permission is obtained from the Spanish government.

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British American Oil Co. Ltd. has indicated long range plans for a new refinery in Nova Scotia, with completion probably in the late 1960s.

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Esso S.A.P.A. has applied for permission to invest $25 to $30 million in new lubricating oil facilities at its refineries in Galvan and Campana, Argentina.

Standard Oil Co. (Indiana) has agreed to purchase the 26,000 b/d Cremona, Italy, refinery of Societa Italia Raffinazione Olii Minerali, and is reportedly considering increasing capacity to 40,000 b/d.

• • •

Ampol Petroleum Ltd. plans a $33 million refinery at Port Alma, on the Queensland, Australia, central coast. The government has granted Ampol an option on 400 acres of land.

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The Defense Energy Department of the government of Thailand has been licensed by Houdry Process Corp. for construction of a 2,000 b/d Houdry catalytic cracking unit at a refinery near Bangkok, with completion date to be late 1961.

• • •

Cities Service Oil Co. Ltd. has started construction of a $1 million hydrodesulfurization unit at its Bronte, Ont., Canada, refinery, the third expansion project at the plant this year. Completion is expected early in 1961.

• • •

Idemitsu Kosan plans a new major refining and petrochemical plant near Tokyo, at Anezaki, Chiba prefecture with at least the refining facility to be completed in the next year.

• • •

What's New in Petrochemicals

Oronite Chemical Co. and Nippon Petrochemicals Ltd. will build Japan's first detergent polymer and alkylate plant at Kawasaki, near Tokyo, with completion planned by late 1961. A newly created company, Nippon Petroleum Detergent Co. Ltd. will operate the plant using Oronite patent licenses and know-how. Oronite has 45% interest in the new firm. Capacity was not disclosed, but the new unit will be able to meet all the country's requirements.

• • •

Dow Chemical of Canada has awarded contracts for its current petrochemical projects. Canadian Bechtel Ltd. will construct the phenol plant on Tilbury Island, near Vancouver, B.C., with completion in mid 1961. Brown & Root will build a penta- and dichloro-phenol unit at Fort Saskatchewan, Alta., with completion early next year. Other units, glycols and amines, are in the engineering stage.

Dow also has several units in the engineering stage for ultimate installation at Sarnia, Ont., to produce propylene oxide, propylene glycol, and polygycol, and expects to start soon on engineering a polypropylene plant.

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Capacity of the $16 million polyethylene plant to be built at San Lorenzo, Argentina, by Duperial, a subsidiary of Imperial Chemical Industries, will be 10,000 ton/yr initially. The ICI high-pressure polymerization process will be used.

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Union Carbide Australia Ltd. has decided to double the capacity of the polyethylene plant now under construction at Altona, Victoria, Australia. Capacity is to be 30 million lb/yr, and first stage of the plant will be in production as planned by mid-1961.

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Enjay Chemical Co. will increase capacity of its Baytown, Texas, orthoxylene unit to 72 million lb/yr from the present 44 million lb/yr, by end of 1960. Capacity can be readily expanded to 165 million if demand requires, company said.

• • •

Sun Oil Co. has awarded engineering and construction contract for its $8 million, 100 million lb/yr naphthalene plant at Toledo, Ohio, to M. W. Kellogg Co. Operations are scheduled to start by end of 1961.

• • •

California Spray Chemical Corp. will build a 1,050 ton/day fertilizers plant at Fort Madison, Iowa. Production will include 150 ton/day ammonium nitrate, 300 ton/day anhydrous ammonia, and 600 ton/day complex fertilizers.

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Ente Nazionale Idrocarburi, Italian state-owned company, plans a $64 million petrochemical plant at Ferrandina, Italy.

• • •

Reichhold Chemicals Co.'s French affiliate, S.A. Reichhold Beckacite, plans a 10.5 million lb/yr maleic anhydride unit at Niort, France. The plant will be designed by Scientific Design Co. Inc. and built by Soc. Francaise des Services Techniques.

• • •

El Paso Natural Gas Products and Rexall Chemical, jointly participating in a petrochemical plant project at Odessa, Texas, have now awarded the following contracts: Fluor Corp. for design and construction of the polyolefin unit for Rexall; Universal Oil Products for the process design of the olefin unit to be operated by El Paso; and Fish Engineering for the mechanical design and construction.

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Cities Service has awarded Badger Mfg. Co. the construction contract for a 120 million lb/yr orthoxylene unit at Lake Charles, La., said to be the largest ever built specifically for orthoxylene production.

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Signal Oil & Gas will build a 1,000 b/d "Hydeal" unit at Houston, Texas, to convert toluene feed to benzene. Procon, Inc., is the contractor, and completion is scheduled for January.

• • •

Synthetics and Chemicals Ltd. will build India's first synthetic rubber plant, near Bareilly. The $30 million plant, with an initial capacity of 20,000 ton/yr, will be constructed by The Lummus Co., and will produce butadiene, styrene, and copolymer.

• • •

Uniao Fabril do Azoto of Portgual and Montecatini have agreed to construct a 40,000 ton/yr urea plant at Labradio, near Barreiro, Portugal. The M. W. Kellogg Co. has the engineering contract.

• • •

Ketjen Carbon Ltd. has completed its 24,000 ton/yr carbon black plant at Rotterdam, the first such plant in the Netherlands.

• • •

Witco Chemical Co. plans a 30 million lb/yr phthalic anhydride plant at an undisclosed site on the USA East Coast, for completion in 1961. In Chicago, where the company now operates a 20 million lb/yr phthalic unit, it is planning a 30 million lb/yr dodecyl benzene sulfonate unit.

• • •

The polyethylene plant to be built by Ethylene Plastique Normandie at Mont, in the Lacq area of France, and announced earlier this year, will be of 15,000 ton/yr capacity.

• • •

Ugilor, a French company, has entered into an agreement with Distillers Co. Ltd. to build an acrylonitrile plant at an undisclosed site in France.

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Shell Oil plans an $18 million, 100,000 ton/yr ammonium phosphate plant at Safi, Morocco.

• • •

Asahi-Dow Ltd. has placed a proposal before the Japanese government for construction of a polyethylene plant at Kawasaki, to use the AGFO process, a new high pressure process developed by A. G. fuer Olefinpolymerization, and licensed by Scientific Design Co. Inc.

• • •

Phillips Chemical Co. is expanding productive capacity of its "Marlex" polyethylene plant near Houston to 100 million lb/yr, an increase of about 25 million over the present output.

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Union Rheinische Braunkohlen Kraftstoff A.G. has put a new 25,000 ton/yr urea plant into operation at Wesseling, West Germany.

• • •

Texaco Inc. has put onstream its new 70 million lb/yr cumene unit at the Eagle Point Works, Westville, N. J., aimed at helping the chemical industry meet the increasing demand for synthetic phenol.

• • •

Maruzen Oil Co. and Dow International plan a 10,000 ton/yr phenol plant as a joint venture at Matsuyama, Japan. The $44 million plant will use the toluol process, and will be the second phenol producer in the country, Mitsui Petrochemical Industries Ltd. being the other.

• • •

Phillips Petroleum has made an offer to the state government of Assam, India, to build a $24 million petrochemical plant near Gauhati, to operate on gases from a 15,000 b/d refinery government is building there. Products would include plastics and, ultimately, synthetic rubber.

• • •

Witco Acquires Sonneborn

Witco Chemical Co. Inc. has acquired 100% interest in privately owned Sonneborn Chemical and Refining Corp. and its subsidiaries in exchange for 300,000 shares of Witco stock.

Three Sonneborn officials have been elected to Witco's board of directors—R. G. Sonneborn; Gustave Schindler, vice president; and Dr. Henry Sonneborn III, vice president and secretary.

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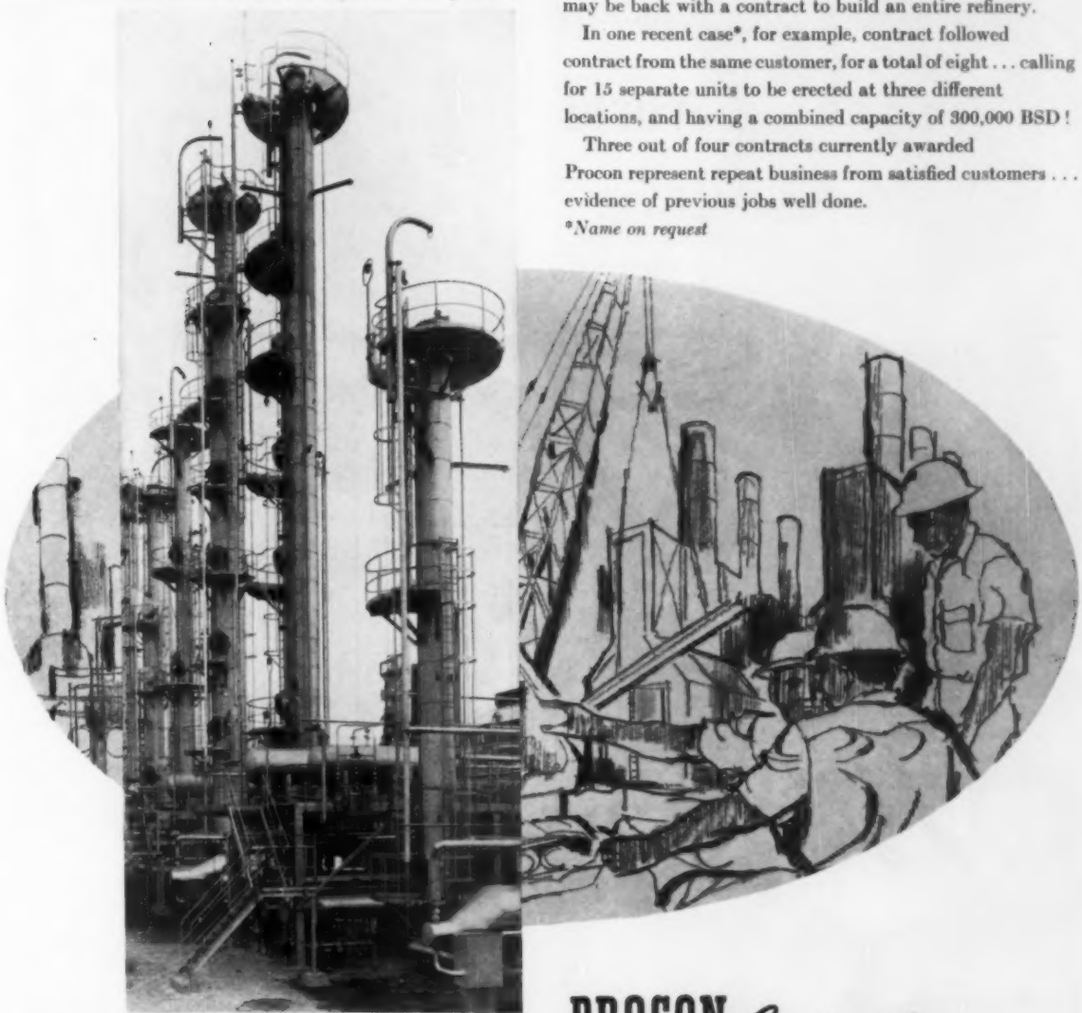

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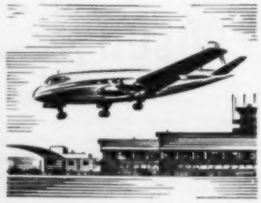

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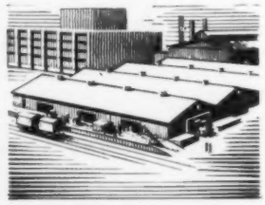

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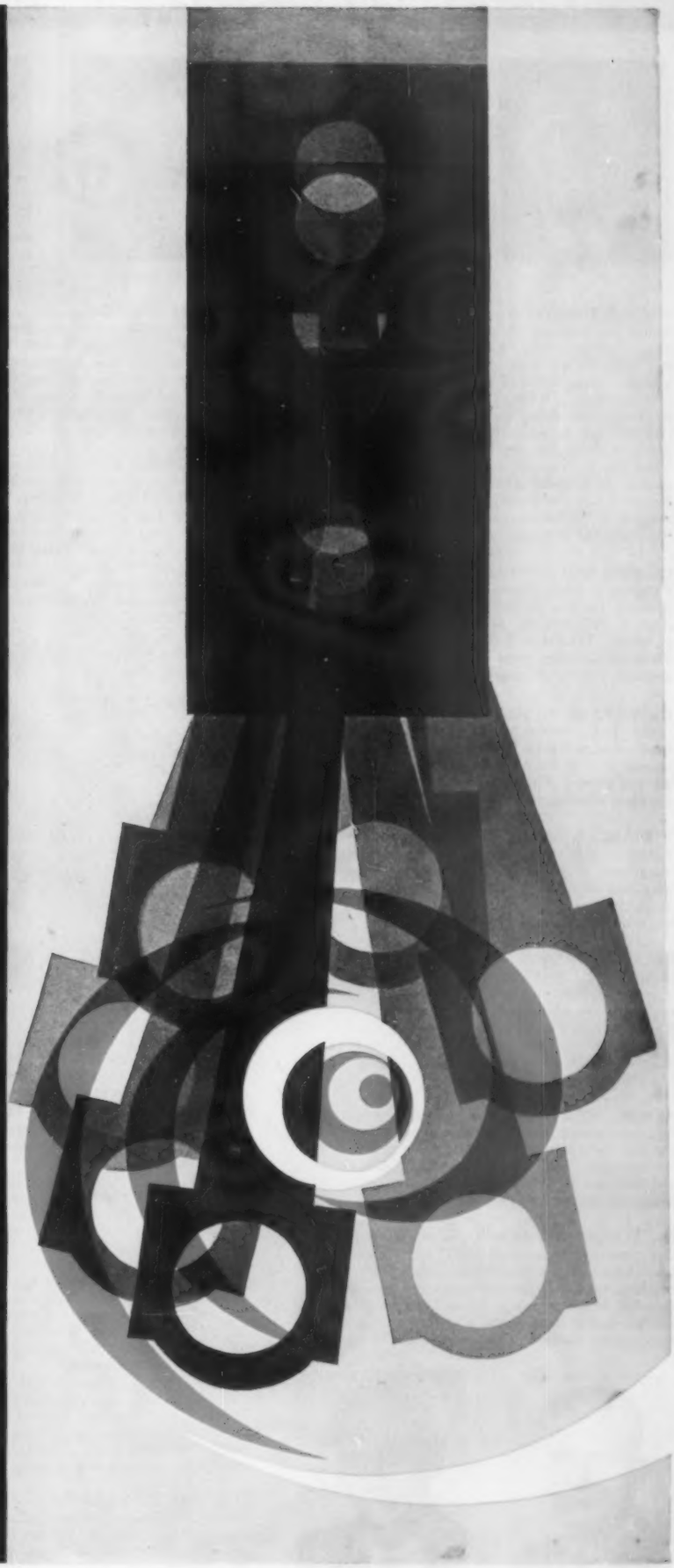

OIL COMPANY STAFF CHANGES

S. T. Taylor

Dr. J. A. Tong

SPENCE T. TAYLOR has been named president for Mobil International Oil Co.'s affiliate, Mobil Oil de Venezuela, succeeding Dr. **JAMES A. TONG,** who has held the top post for 12 years. Dr. Tong will continue in an advisory capacity pending his retirement January 1. Taylor joined Mobil de Venezuela as chief of the subsurface section of the western division and rose to become exploration manager in 1955 and executive vice president in February 1959. Dr. Tong has been at the helm of Mobil de Venezuela during its greatest period of growth, including the completion of the Barinas-El Palito pipeline, the new refinery at El Palito, and the entrance of the company into the Venezuelan gasoline market.

Dr. RICHARD C. WEART, who has been on an assignment in Paris, France, has been named head staff geologist for Sun Oil Co.'s foreign operations department at Philadelphia. He succeeds the late Herbert J. Weeks. **THOMAS F. RITTER,** who moved to the Philadelphia office from Bolivia in January, will be assistant head staff geologist.

Dr. WERNER F. SCHNEEBERGER of Ball Associates, Ltd., Denver, is in Australia on behalf of American and British interests. Dr. Schneeberger previously worked in Australia for Royal Dutch Shell and the Bureau of Mineral Resources of the Commonwealth Government of Australia.

HOWARD B. SHELTON has resigned from Sohio Petroleum Co. and opened offices as a petroleum consultant in Houston. Recently Mr. Shelton was northwest division manager for Sohio in Billings, Mont. Formerly he was manager of the natural gas division in Oklahoma City.

BRUCE K. BROWN, who served as Deputy Administrator of the Petroleum Administration for Defense during the Korean War, has resigned as chairman of Petroleum Chemicals, Inc., New Orleans. Mr. Brown, a former vice president and director of Standard Oil Co. (Indiana), has established an office as a business consultant in the Oil and Gas Building, New Orleans.

ALBERT H. ZINKAND to manager of Tidewater Oil Co.'s export department, succeeding R. S. McLaughlin who is retiring after 27 years of service with the company and its subsidiaries. Mr. Zinkand, former assistant to Tidewater's marketing manager, has been with the company for 30 years.

Dr. ALEXANDER LEWIS, Jr., has been elected a vice president of the Gulf Oil Corp. Formerly manager of the petrochemicals department, Dr. Lewis will continue to direct the company's world-wide petrochemical interests, which include the manufacturing and marketing of ethylene, propylene, benzene, toluene, isooctyl alcohol, and detergent raw materials.

Dr. A. Lewis

O. F. Van Beveren

T. B. Kimball

C. J. Allen

THOMAS B. KIMBALL, already a director, has been elected executive vice president-operations, Sinclair Oil Corp. **C. J. ALLEN,** since 1957 a vice president of Sinclair Oil Corp., has been elected president and chief executive officer of Sinclair Refining Co., succeeding Mr. Kimball. In his new post, Mr. Kimball will coordinate the operating activities of all domestic and foreign subsidiaries for the parent company.

ALESSANDRO ZATTI, a director of Esso Italiana for many years, has been elected a vice president. **C. J. HEDLUND,** resigned as manager of the coordination and petroleum economics department of Standard Oil Co. (N.J.), was elected a director and vice president of Esso Italiana at Genoa. R. T. Bonn of Esso Export Corp., was elected a director of Esso Italiana to succeed E. G. Broming, who transferred to Jersey Standard. L. Pittaluga, assistant comptroller of Esso Italiana, was appointed comptroller of that company to succeed **D. J. THOMPSON,** who resigned from Esso Italiana to become director of Esso Switzerland.

DR. ROBERT R. WHITE has been elected vice president of The Atlantic Refining Co. Also he was appointed general manager of the research and development department.

R. R. White

Dr. A. Farkas

Dr. ADALBERT FARKAS, assistant director of research, Houdry Process Corp. of Philadelphia, has been elected president of the International Congress on Catalysis, Inc. at the 2nd International Congress on Catalysis recently concluded in Paris. Dr. Farkas had served for four years as director of the International Congress on Catalysis, which is the continuing sponsor of these meetings.

W. ROLLAND STEWART, vice president and general manager of Bay Refining Co., has ended his association with Bay Refining to devote full time to other business enterprises with which he is connected.

DOUGLAS G. G. LEVICK has been appointed coordinator of marketing at Standard-Vacuum Oil Co.'s international headquarters at White Plains, New York. He succeeds the late Mac Donell Roehm. In this capacity Mr. Levick assumes the over-all direction of the company's marketing activities in more than 50 countries and territories in the Far East, Southern and East Africa, Australia and New Zealand. Mr. Levick joined Standard-Vacuum as manager of the marketing operations and cost department of the Marketing Coordination Division. He was named assistant coordinator of marketing in 1958.

O. F. VAN BEVEREN has been elected president of American Overseas Petroleum Ltd. (Amoseas). The company is a member of the Caltex group of oil companies which operate in the Eastern Hemisphere. Mr. Van Beveren, formerly a vice president of Amoseas, succeeds G. M. Cunningham, who is retiring.

Left to right, President John E. Swearingen and Chairman Frank O. Prior

FRANK O. PRIOR, who rose from a roustabout in the oil production fields to chairman of the board and chief executive officer of Standard Oil Co. (Indiana), has retired after 41 years' service. President John E. Swearingen will become chief executive officer, and the office of chairman will be discontinued. Mr. Prior was paid tribute by President Swearingen for his leadership in the growth and progress of the company, for his guidance in the current proposed corporate reorganization, and for his contribution in "building a young, aggressive, and seasoned management both in the parent company and its subsidiaries."

Mr. Prior joined Midwest Refining Co., a former Standard Oil subsidiary, in 1919 as a roustabout in the Salt Creek field of Wyoming and progressed to director and vice president in charge of production of Standard in 1945, and was elected executive vice president in 1951. He became president in 1955. In 1958 Mr. Prior was elected chairman of the board and chief executive officer of Standard Oil Co. (Indiana).

JOHN F. HARRON, from manager of Sun Oil's Toledo refinery to the advanced management and methods division of Sun's manufacturing department. He will headquarter at Marcus Hook, Pa., and will replace **PAUL D. BARTON** as director of the division when Mr. Barton retires around the end of this year.

RUNE E. SWANSON has been appointed comptroller of Mobil Chemical Co. He will continue to function as assistant comptroller of the parent company.

A. C. WILANDER has been named manager of the purchase and stores department of Standard Oil Co. of California, West Operations, Inc. He succeeds **W. H. KLARQUIST** who was recently named general manager of purchasing for the parent Standard Oil Co. of California. Other appointments to the Western Operations purchasing staff included **N. D. TICHENOR** as assistant manager (purchasing) and **W. W. SHARON** as assistant manager (operations).

R. E. LUDT, executive assistant to the chairman and planning coordinator for California Texas Oil Corp., has resigned to join Hoover Worldwide Corp. as senior vice president and a director.

BILL W. DAVIS has been named executive assistant to the management of Allied Oil Co., Cleveland. He formerly served in Ashland, Ky., as special representative in the refinery sales division of Ashland Oil.

LEO V. GRIGONIS has been named general manager for the Mobil companies in Ghana, Sierra Leone, and Liberia. He will be headquartered in Accra, Ghana. He replaces **RICHARD M. SHERIDAN,** who is returning to the United States for advanced management training prior to reassignment.

D. G. G. Levick

L. V. Grigonis

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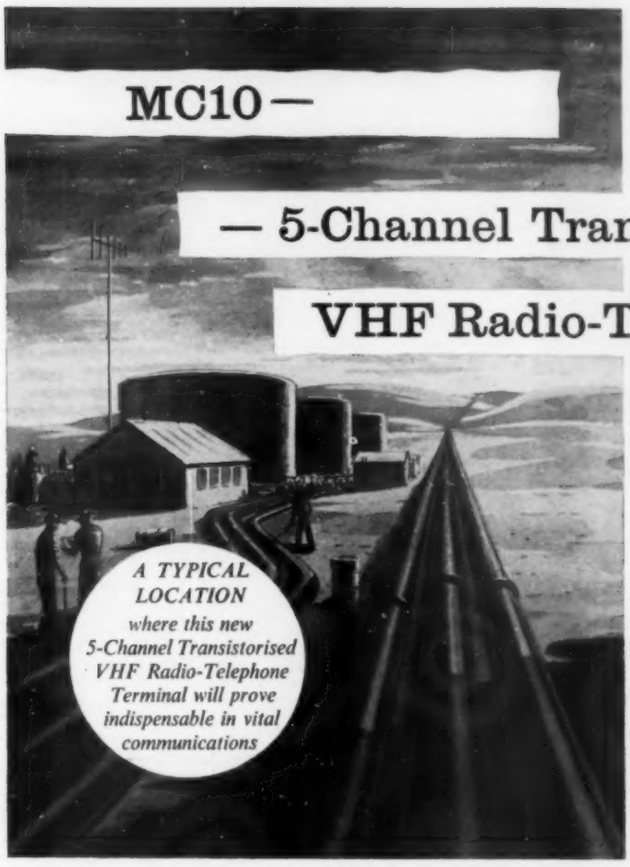
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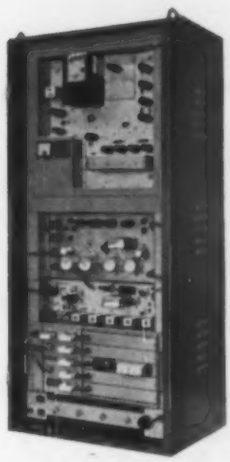

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INTERNATIONAL NEWS AND NOTES

AFRICA—Crude production in Gabon and the Congo was 753,000 tons during 1959, a gain of 50% over 1958, according to Ste. des Petroles d'Afrique Equatoriale. Oil exploration has been cut to five or six drilling rigs. No sizable oil fields were found, and reserves are estimated at ten million barrels.

AUSTRALIA—The work of the Snowy Mountains Hydro-Electric Authority on a new dam 3,500 feet up in southeast Australia has been kept going through the winter, when other means of access became impassable, by the delivery of BP fuel and lubricants by parachute. This £442 million scheme, which began 10 years ago, has to be kept to a strict timetable if the 1975 target date is to be met.

AUSTRALIA—The Petroleum Information Bureau (Australia) has forecast Australia's oil consumption for the full year 1960 as 2,975 million Imperial gallons, the equivalent of 232,900 b/d—a 10.2% increase over actual consumption of 2,700 million gallons, or 211,300 b/d, in 1959.

AUSTRIA—Austria's crude reparations shipments to USSR and satellites are expected to be cut to 10,000 b/d from 20,000 b/d under a new agreement by which shipments will end in 1964 instead of 1965. Net exports will remain at the same level, as Russia will discontinue sending back into Austria 10,000 b/d. Austria will register a gain because its oil is of much higher quality than the Russian high-sulfur crude.

BAHRAIN—Construction of the new island wharf at Sitra has been started by Bahrain Petroleum Co., as part of a modernization plan to be completed by the end of 1961. The wharf will be one of two to replace an existing structure. The new facilities will permit the company to berth tankers up to 45,000 tons.

EGYPT—Thirty wells were drilled during 1959 in proved fields near the Gulf of Suez; all but one found oil, the General Petroleum Authority reports. Total footage drilled was 169,844. Another 10 wells were being drilled at the end of the year. General Petroleum Co. completed 15 wells, one of them dry; Eastern Petroleum Co. (COPE) completed 12, and Anglo-Egyptian Oilfields Ltd. completed three. Total wells drilled to end of last year was 585.

Crude production was 9,279 tons daily, a drop of 2.5% from the 9,515 tons daily of 1958. Production at Belayim was 4,100 tons daily, up from 4,088 tons in 1958—accounted for by Eastern Petroleum Co., which also showed 1,139 tons daily at Abu Rudeis against 1,172 in 1958; 48.68 tons in Feiran against 48.21 tons in 1958; and 111.3 tons in Sidri against nothing in 1958.

Production at Ras Gharib by Anglo-Egyptian Oilfields Ltd. was 2,805 tons daily, a drop of 9.4% from 1958; and at Hurghada it was 98.31 tons, up 1.5% from 1958.

Anglo-Egyptian Oilfields, Ltd. and Mobil Oil Egypt in 1959 had output of 480.5 in Sudr, down 14.4% from 1958; of 455.9 in Asl, up 0.7% and of 42.68 in Ras Matarna, up 24.98%.

FRENCH SAHARA—The French government has granted 10 new exploration permits in the Sahara in the first half of 1960. They cover 60,470 square kilometers (about 23,245 square miles). They require total minimum investment of $30.4 million. They include two American companies entering the area for the first time: California Asiatic Oil, and Texaco Overseas Petroleum—each with 20% interest in a Zemoul-el-Akbar permit, shared with Regie Autonome des Petroles and with Petropar.

GERMANY (West)—Continental Oil Co. has acquired, through its subsidiaries, control of Sopi Mineralprodukte GmbH, a leading independent petroleum marketing organization in West Germany and Austria which markets oil products through some 360 retail outlets.

GERMANY (West)—Crude production in West Germany came to 2,711,852 metric tons in the first half of 1960, up 10.4% from a year earlier. Refinery output was 12,605,283 tons, up 26.4%. Earlier forecasts of production of 5.6 million tons for all of this year appear accurate; forecasts are for output of crude of 6.5 million tons by 1964. Estimates of refinery output of 28 million tons during 1960, however, appear low. The 26.4% increase in the first half of this year compares with an increase of 43.9% between 1958 and 1959.

GERMANY (West)—A subsidiary of Cie. Francaise des Petroles has purchased service stations from German marketers and has some of its own building in West Germany.

GERMANY (West)—A 110 b/d producer was found in northern West Germany jointly by Elwerath and Mobil, between Bremen and Minden. Wehrbleck-Ost-2 flowed 33-gravity crude from a 69-ft section topped at 2,690 ft.

WEST GERMANY—Continental Oil Co. of Houston, Texas, has acquired, through its subsidiary companies, control of SOPI Mineralprodukte Gm. b.H. (SOPI Mineral Products Co.), a leading independent petroleum marketing organization in West Germany and Austria. SOPI markets petroleum products under the "SOPI" brand through approximately 360 retail outlets.

GREECE—An exploration agreement has been signed by Greek government officials with Aetoliki Petroleum Co., owned 51% by National Bank of Greece and 49% by BP of Greece Ltd. Area covered is Aetolo-Akarnania in West Greece and the islands of Cephalonia and Lefkas. This is the sixth exploration and development agreement the Greek government has concluded. Others are Esso Hellenic Inc.; Romanian government; Hunt International Petroleum; Helios-Regie Autonome des Petroles; and French Petroleum Inst. The agreement calls for first deep drilling within 18 months of ratification by the parliament; surrender of 50% of the area after three years, and 50% of the rest after six years; 50% tax on net income; and 12½% royalty (deductible from the tax).

INDIA—S. Kherea, secretary of India's Oil Ministry, will visit Britain, France, Italy, the USA in an effort to interest oil companies in exploration in his country. Though it has relaxed its requirements, India thus far appears to have received only nibbles from prospective oil investors.

INDIA—Standard of Indiana has been reported negotiating with the Indian government for acreage under its newly revised oil laws, as well as seeking a possible refinery site in Madras in the southern part of the country.

INDIA—According to present estimates, India's annual oil requirements will be 14 million tons by 1965, and between 30 to 40 million tons by 1975, as compared with seven million in 1959. At present, 400,000 square miles are considered potential oil-bearing sedimentary areas. A survey of an additional 2,859 square miles is proposed by India's oil and gas commission during the 1960-61 season as part of its program for an investigation of the country's probable oil areas. Regions to be covered this year are the Panjab, Assam, Cambay, and Cutch.

INDIA—First Russian petroleum products were to be distributed in India in September under agreements of Oil India Ltd. to import 1.5 million tons of high-grade kerosine, jet fuel, and high-speed diesel oil in the next 3½ years. Standard Vacuum Oil Co. is reducing its prices of products by 8.5%, Burmah-Shell by 7.5%, and Caltex (India) Ltd. by an unnamed amount. The three refineries refused to process Russian crude oil, on grounds the plants were for their own contracted crude.

INDIA—India has ended negotiations to import Soviet crude oil because Western-owned companies in India refused to process it. To meet the threat of Soviet competition, the Western companies (Caltex, Burmah-Shell, and Standard-Vacuum) reduced by 11% to 12½% the prices of crude oil they import from Persian Gulf sources.

IRAQ—Iraq Petroleum Co. and associates report drilling during the first half of 1960 as follows: IPC had three exploration wells in Iraq—Demir Dagh 1 to 6,769ft, Gilabat 2 to 5,162 ft, and Qarah Chauq 1 to 1,239 ft. BPC also had three exploration wells—Dujaila 1 to 7,597 ft, Ghalaisan 1, abandoned 7-25-60 at 6,533 ft; and Kifl 1, abandoned 7-26-60 at 10,684 ft. MPC had one exploration well—Alan 2 to 2,700 ft. Qatar Petroleum Co.'s one exploration well, Fuwairat 1, was at 5,277 ft. To the end of July there was no drilling in the Trucial Coast by PD (TC)—but Murban No. 4 was spudded August 4.

IRAQ—Iraq, Basrah, and Mosul Petroleum companies report that Iraq's oil production for 1959, at 40.89 million long tons, was some 17% above 1958; and earned revenues for the Baghdad government worth $242.2 million.

ITALY—$670.4 million is the budget Italy's State oil agency ENI has planned for the four years 1960 through 1963. Expenditures are to include $179.2 million for exploration, production, transportation, and distribution of methane; $182.4 million for refining, transportation, and marketing; $192 million for petrochemicals; $80 million for the nuclear industry; and $36.8 million for miscellaneous.

ITALY—The Italian agency Ufficio Petroli & Unione Petrolifera has estimated oil consumption in Italy for the full year 1960 at 18,536,900 tons, or about 370,738 b/d—calculated on the basis of available figures and estimates for the first six months for the major products, and for the first five months for the minor products.

ITALY—Rome sources report that ENI (Italian State oil agency) has signed a trade agreement whereby Italy will import during 1961 six million tons of Soviet crude and several hundred thousand tons of fuel oil. With payment to be made in machinery, rubber, and other items, the Russian price to the Italians should figure out to 40% below the world market.

ITALY—According to official sources, Italy during the first six month of 1960 imported 13,589,616 tons (something over 270,000 b/d) of crude oil valued at 139,616 million lire—a rise of 13½% over the

(*Continued on page* 85)

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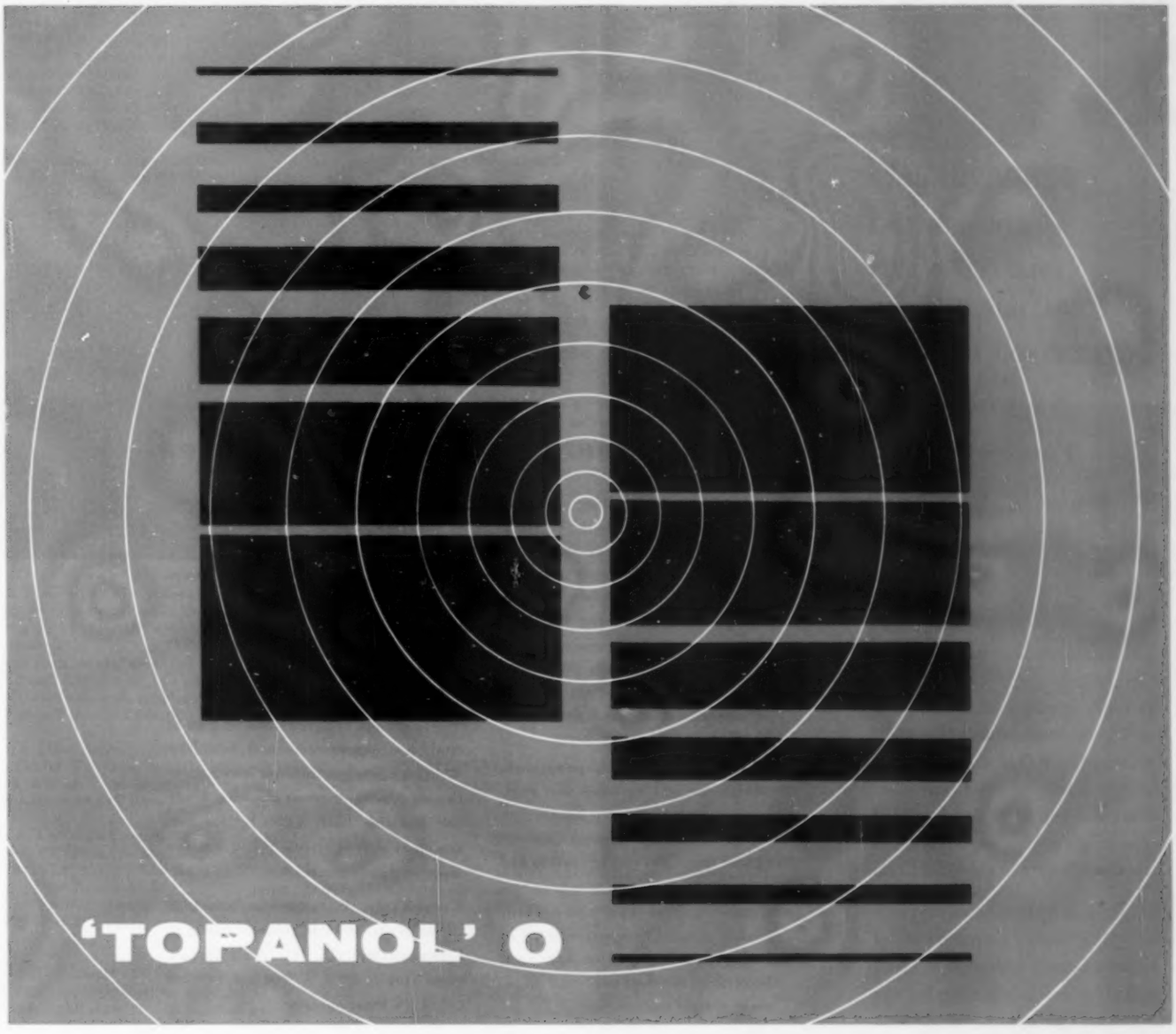

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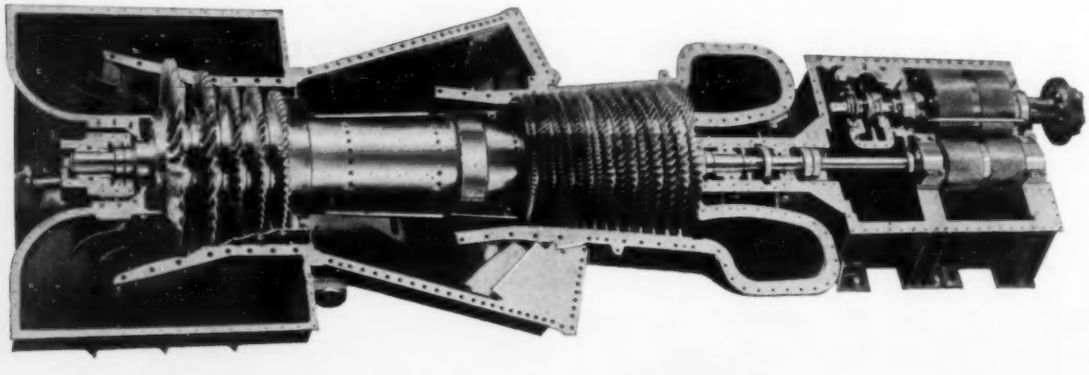

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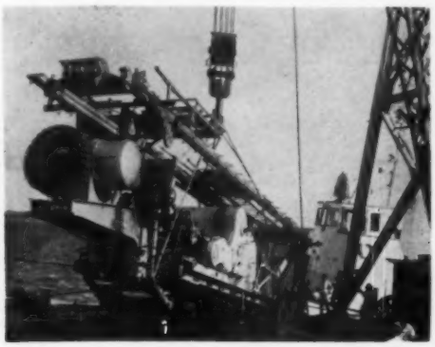
11,972,580 tons (valued at 135,460 million lire) in the comparable 1959 period. Crude exports totaled 295,192 tons against 188,072 tons in the first six months of 1959. Oil-product imports in the same period were 864,986 tons (about 17,300 b/d), against 266,740 tons in 1959. Exports of refined products in the first half of 1960 amounted to 4,391,580 tons (about 88,000 b/d against 4,128,619 tons in the same 1959 period, or a rise of about 6.4%. The value of the exported products is 63,894 million lire.

JAPAN—Japanese importing firms are demanding lower prices from Russia following the break in Middle East crude prices. Idemitsu, Japan's biggest independent, wants new discounts from Gulf Oil Corp. which supplies about 60% of its crude.



KENYA—The first of a series of medium depth stratigraphic holes to be drilled in the Lamu area of Kenya was started by BP-Shell Development Co. of Kenya in August. This is on the Tana River, some 30 miles south of Bura and is being sunk by a 6,000-ft portable Forasol rig. The aim of this series is to provide geological information to supplement the knowledge already gained by seismic work.

KENYA (East Africa)—BP-Shell Petroleum Development Co. of Kenya is reported to have started the first of a series of medium-depth stratigraphic holes in the Lamua area of Kenya.

KUWAIT—Crude production by Kuwait Oil Co. was 287,857,068 bbl in the first half of this year, and exports were 254,937,352 bbl. Some 73,565,060 bbl went to the United Kingdom; 34,372,630 to Japan; 29,317,731 to The Netherlands; 24,254,328 to France; and 21,419,748 to the USA. Another 77,903,303 bbl went to Aden.

KUWAIT—Kuwait Oil Co. has been reported planning commerciai-production facilities at its "significant" Minagish discovery in South Kuwait last year. Drilling to define the limits of the field 21 miles west of Burgan is continuing.

KUWAIT—His Highness the Ruler of Kuwait has nominated two Kuwaiti nationals—Feisal Mansour Mazidi and Mahmoud Khalid al-Adasani—to be directors of Kuwait Oil Co. Mr. Mazidi graduated in England in economics with honors from the University College of North Staffordshire in 1959, and Mr. Adasani graduated in petroleum engineering from the University of Southern California in 1958.

The board now consists of 10 directors—a managing and assistant managing director, two Kuwait government-appointed directors, and six others appointed equally by B. P. (Kuwait) Ltd., and Gulf Kuwait Co. In addition, Sir Philip Southwell, CBE, is an advisory director.

KUWAIT—Kuwait Oil Co. (jointly owned by Gulf Oil Corp. and British Petroleum) has added two Kuwaiti nationals to its board, increasing total directors to ten plus one advisory director. The two appointed by the Sheikh of Kuwait are Feisal Mansour Nazidi and Mahmoud Khalid Al-Adasani.

LEBANON—Site for a second wildcat by Cie Libanaise des Petroleum (50% owned by the German firm Elwerath) has been selected east of Sidon. In the northern Bekaa valley, the company's No. 1 El-Kaa has gone below 4,920 ft.

LIBYA—Bechtel Corp. of San Francisco, will build the 100-mile 30-in. pipeline to bring crude from Esso's Zelten field to the Marsa el Brega terminals. With pipe-laying operations to begin near the end of this year, the line is scheduled for completion within six months—though more work will have to be done before the line can start operation. This will include drilling development wells near the beginning of the line and building terminal facilities. Esso Standard Libya Inc. expects to begin exporting crude from its Libyan concession some time during the first half of 1962.

LIBYA—The German firm Deutsche Erdoel will start its first Libyan wildcat in concession No. 77, Zone IV, on a 15,440-square-foot concession obtained two years ago.

LIBYA—Total productive oil wells in Libya number 35, and there are three gas wells. Rated production to date is 81,975 bbl of oil and 16.5 million cubic feet of gas. Drilling rigs in operation number 34.

LIBYA—For possible entry into the oil search in Libya, Sinclair Oil Corp. has formed a Libyan affiliate, Libya-Cities Service Petroleum Corp., in Delaware. Earlier, Pure Oil and Sun Oil companies had set up Libyan affiliates, also incorporated in Delaware.

MOROCCO—Though ENI several weeks ago denied an oil find, Madrid press sources now report ENI's affiliate "Agip" Petroleum Co. struck oil in commercial quantities in French Morocco at Tarfaya, 370 miles inland from the Atlantic Ocean and 18 miles north of the Spanish Sahara, where American oil companies are exploring.

PAKISTAN—Reports from Karachi say the Pakistan government has officially accepted the Soviet offer to explore Pakistan's mineral resources, including oil. The offer originally was made by the Soviets last November.

PAKISTAN—The Pakistan government has granted renewal of an oil prospecting license held by Pakistan Oilfields Ltd., Rawalpindi, over the Mahssian area covering 8,300 square miles in the district of Jhelum of Rawalpindi division. Renewal is effective as of May 3, 1960.

PHILIPPINES—Approved by the Philippine congress and awaiting the president's signature is a supplement to the generally favorable oil law which would grant a 27½% oil depletion allowance.

SICILY—The Comiso and Caltanissetta research permits in Sicily held by Macmillan Petroleum Corp., were renounced to the Sicilian Government as of June 16, 1960, the expiration date of such permits. The company's sole remaining interest in Sicily is its 2% overriding royalty interest in some 35,000 acres located between the Comiso permit and Gulf Oil Corp.'s Ragusa concession. On the basis of information received to date, it appears that Gulf has no present plans for further drilling on this acreage.

SPAIN—INI (Spanish government agency) has been authorized to join with three French State companies (Petrorep, Repga, and RAP) in the formation of two new companies in Spain, each of which will explore 1.5 million acres on INI's reserve acreage.

SPANISH SAHARA—On approval by the Spanish government of an operating agreement, Pure Oil et al. have decided to begin immediate exploration of a 1,388,000-acre concession in the Spanish Sahara. With Champlin Oil & Refining and Sun Oil Co. as partners, Pure Oil has planned a seismic program expected to take a year.

SPANISH SAHARA—Tidewater Oil Co. announced August 19 that it has signed final agreements with the Spanish government granting Tidewater and the Standard Oil Co. (Ohio) exploration licenses for nine blocks of land in the Spanish Sahara. The Spanish government revealed last March that it had awarded eight exploration permits to Tidewater and Sohio. A ninth block was obtained during formal completion of the working agreements, H. H. Neel, general manager of Tidewater's foreign exploration and production division, announced. Principal operating base for the exploration work will be in Las Palmas in the Canary Islands, some 120 miles off the African Coast. In addition to the Saharan blocks, Tidewater and Sohio have exploration permits for four adjacent blocks in the Guadalquivir Valley in southwestern Spain.

(*Continued on page 92*)

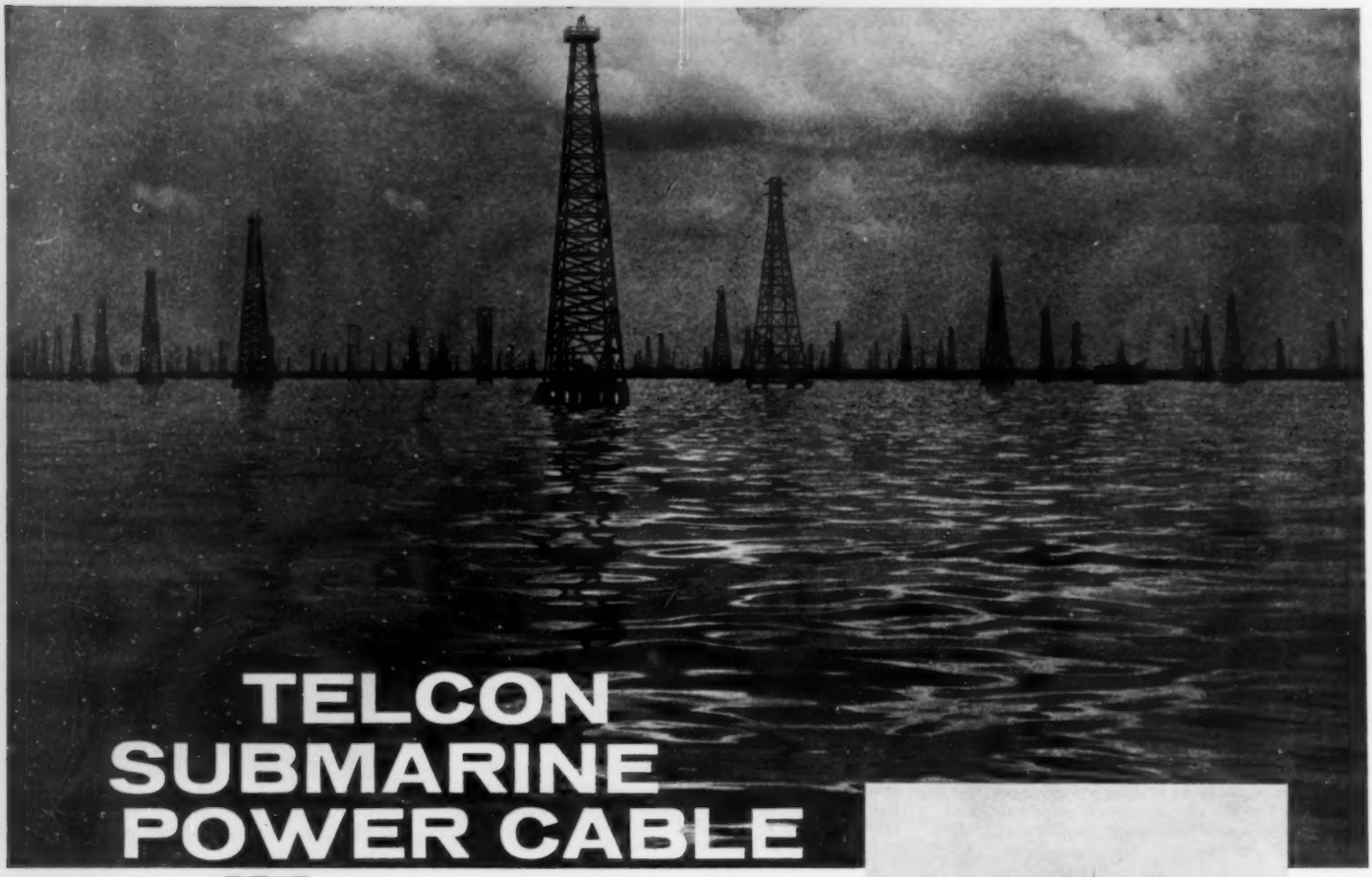
Westinghouse

GAS TURBINES FOR VENEZUELAN OIL HANDLING ARE REMOTELY CONTROLLED

This gas turbine power plant at Puerto Miranda, containing two 5,000-kw gas turbine-generator units, was built by Westinghouse for Compania Shell de Venezuela. It supplies power for oil storage and tanker-loading facilities.

The first such installation designed to be remotely controlled, the plant is operated from a central control room at the tanker-loading area. There, one man may remotely operate the two Westinghouse gas turbines and regulate the tanker-loading facilities.

Gas turbine plants are only one of many ways Westinghouse helps speed operations of the petroleum industry. Switchgear, generators, transformers, relays and controls are among Westinghouse products of advanced design and dependable performance in 'round-the-clock use today by petroleum companies throughout the world.



TELCON SUBMARINE POWER CABLE IN VENEZUELA

This is the Lagunillas Oilfield of Compania Shell de Venezuela, one of the most extensive in Venezuela, with, inset, an offshore pumping station in Lake Maracaibo.

For installations here TELCON designed and supplied, to exacting requirements, some 170 miles of 11.5 Kv. armoured, polyethylene insulated submarine cable for power transmission to offshore pumping stations.

In addition TELCON have supplied 50,000 yards of 1 Kv. submarine cable to the Creole Petroleum Company, and submarine telephone cable for communication with offshore rigs, etc. The power cable was specially designed to combat the extremely corrosive conditions of Lake Maracaibo, and the ravages of the Teredo boring worm. TELCON polyethylene insulated cable is much lighter in weight than the conventional lead-sheathed type, making for ease of handling and installation, and is superior for submarine use. It lasts longer, not being subject to 'old age fracturing', is less expensive, and is able to withstand considerable mishandling.

TELCON were world pioneers in the development of this type of cable, and have led the field ever since. For underwater installations, such as in Lake Maracaibo, TELCON have probably supplied more cable than any other manufacturer, and all over the world, wherever vital installations depend on cables, you will find TELCON. In the Petroleum Industry, on land or underwater, TELCON cables are the best for the job. In experience of cable manufacture, and technical 'know-how' TELCON are second to none—well over 100 years' experience sees to that.

If YOU have any problems where cables are concerned, write to us now; we are confident that we will be able to help you.

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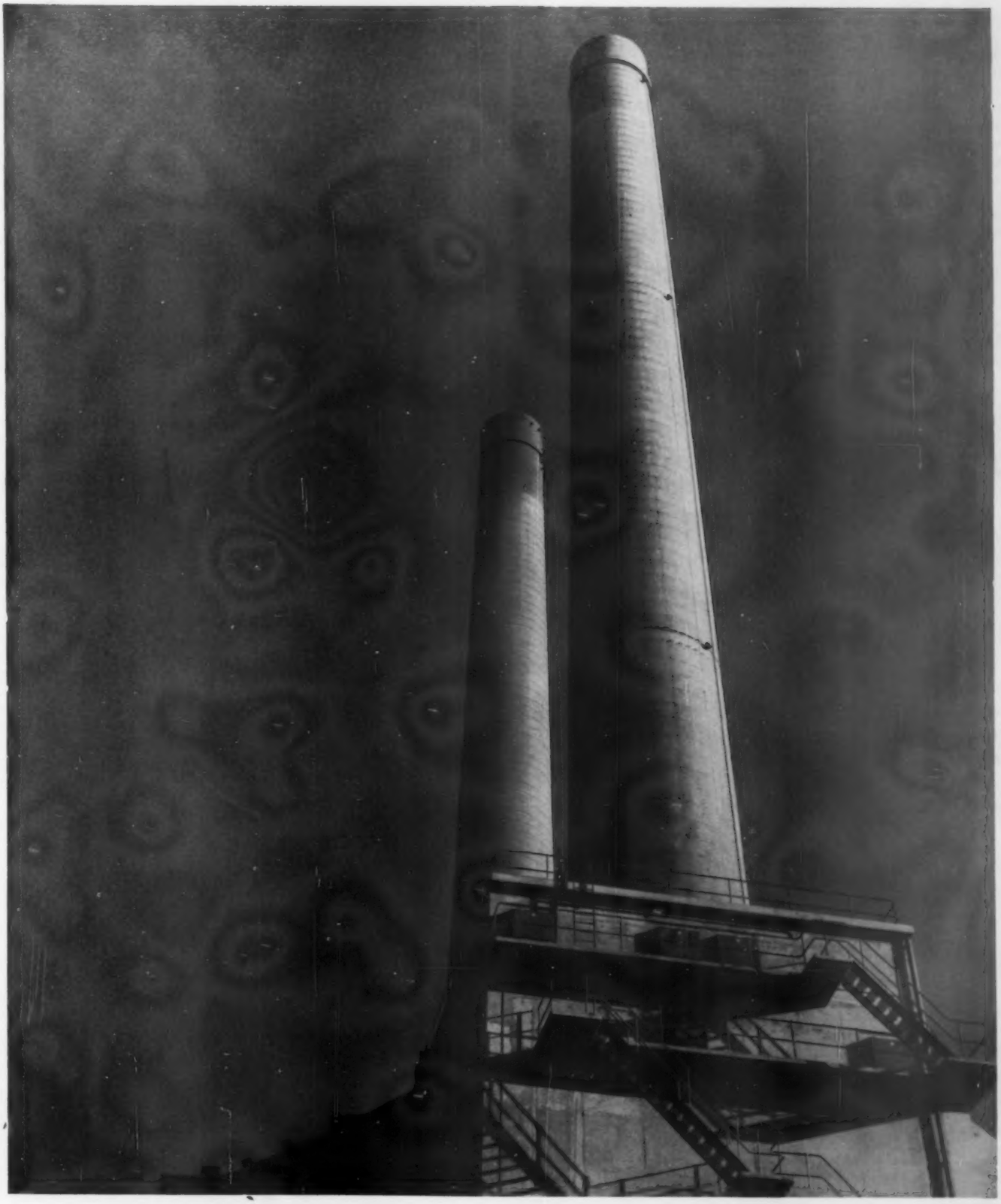

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World Tanker Fleet

(Continued from page 42)

The principal features are the replacement of tables by formulae, the inclusion of design features in the data from which the scantlings are calculated, and the importance attached to satisfactory loading. A departure from the practice of the 1959 rules is the expression of the section moduli of the stiffening members in association with "an effective width of plating." In other words, whereas the geometrical properties of these members were previously calculated in relation to plating of a fixed width—the calculations allowing for the possibility that this width might at any given point be slightly greater or less than the figure assumed—the geometrical properties of the stiffening members under the new rules are related to precise and varying widths of plating. This has entailed the production of new tables of a most comprehensive nature.

A British tanker with nuclear power is seen by many as inevitable even though progress towards the goal is very slow.

An atomic ship can be built and operated within acceptable safety standards. This was the main general conclusion of an independent panel of experts appointed by the UK government to advise the Minister of Transport on the problems arising at sea and in port which presented its report this year. It is a comprehensive and valuable one, especially from the aspects on which it is felt international agreement is essential.

The only ships seen as having any prospect of economic nuclear propulsion are large passenger vessels or tankers having shaft horsepowers of 20,000 or more, and no objection is seen to carrying petroleum. The possible effects of reactor accidents are considered for all aspects and the government accepted the committee's recommendations as an excellent basis for legislation in due course.

Subsequently, proposals put forward by industry for a 65,000-dwt tanker were assessed by the Committee for the Application of Nuclear Power to Marine Purposes of the Ministry of Transport. As a result, the government invited proposals, in the form of tenders by end-July, for a 65,000 dwt tanker to be powered by either a boiling water reactor or an organic liquid moderated reactor of British design. The ultimate object, it is stated, is to build a nuclear-powered ship that is economically competitive with a conventional one.

Reactors of both types can, according to the UK Atomic Energy Authority, be built for about £1,500,000. In its recent report for 1959-60 it stated, however, that it had made design studies of possible marine reactor systems and from this had drawn the general conclusion that systems on known techniques will not compete on an economic basis with conventional ship propulsion. Considerable improvements will be required before economic operation is likely.

Meanwhile, in preparation for the future, Lloyd's has recently published the first Classification Rules for Nuclear Ships. Specific and detailed requirements are laid down for materials, longitudinal strength of hull, pressure vessels and components, reactor engineering and control and the provision of emergency power. But adequate provision is made for submitting proposals so that designers are free to put forward original ideas, or for modifications or amendments. Although "provisional," at least the rules in their present form give authoritative guidance as a "safety charter." END

1260 horsepower to put where you please

The Ruston skid-mounted 'TA' gas turbine is the lightest long-life power package ever!

Here's a rugged lightweight unit for pump, compressor, or generator drive ... 1260 reliable horsepower available two minutes after pressing the starter button. All the auxiliaries are mounted on the skid and the complete air-cooled unit weighs only 18,000 lb.

Whether mounted on a drilling platform or sitting on only 6" of concrete, this Ruston 'TA' will run unattended in conditions from Arctic cold to tropical heat .... existing installations show that overhaul periods are way over 10,000 hours.

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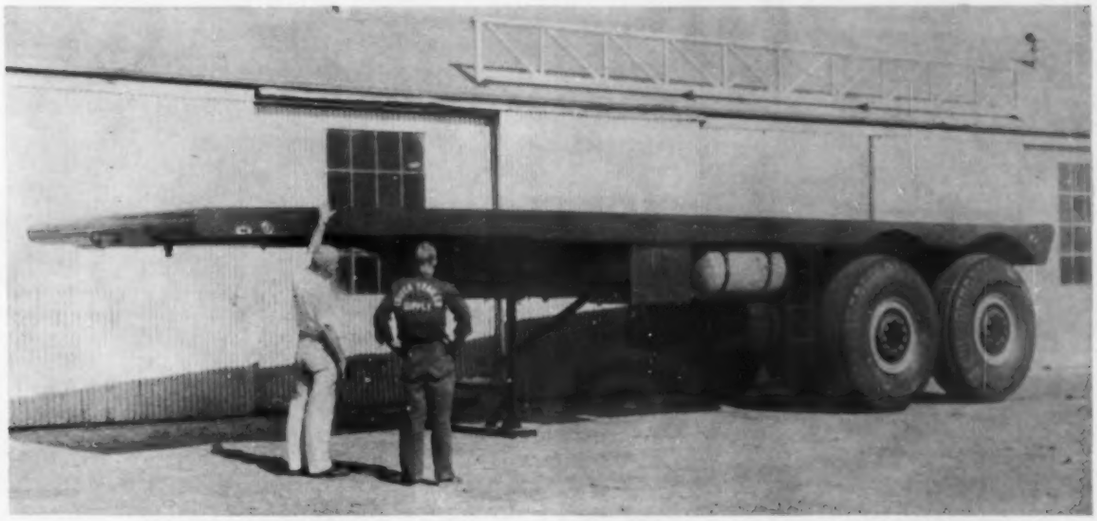

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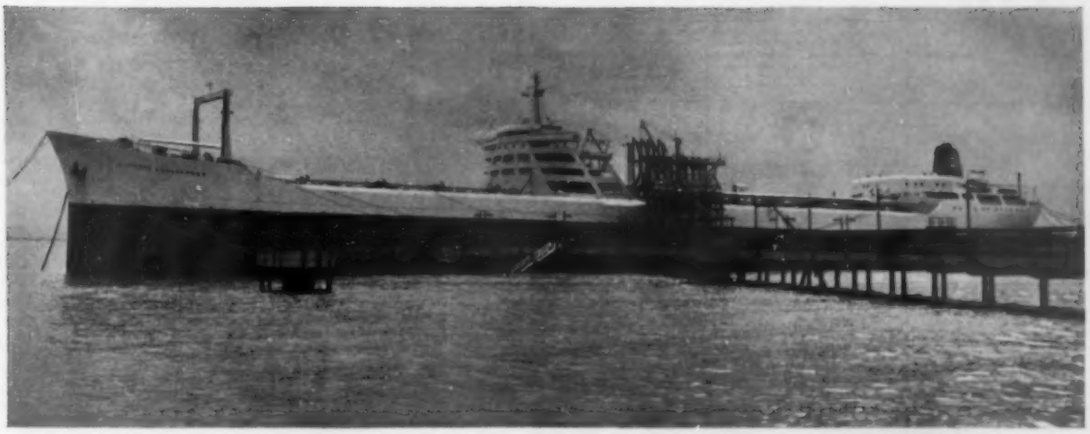


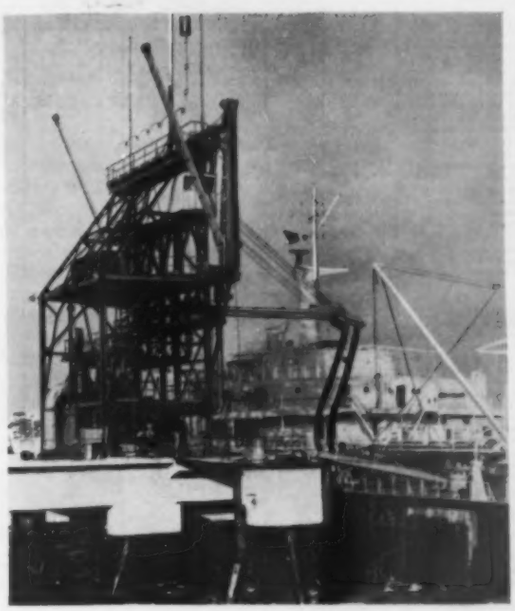
WOODFIELD FLOW BOOMS

Load and unload tankers from 2,000 D.W.T. to 105,000 D.W.T. and allow for manifold rise and fall of 85 ft.

Top illustration: The "Olympic Challenger", 65,000 D.W.T. Super Tanker berthed at No. 10 jetty London & Thames Haven Wharves Ltd., Thames Haven Essex.

Left: View of Woodfield Flow Booms.

Lower illustration: Woodfield six-unit Flow Boom Equipment, one of three installations in operation at Wilhelmshaven for the Nord-West Oelleitung gmbh.



- ★ Shortest rubber hose length per connection of any system.
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World Petroleum Statistics

FREE WORLD SUPPLY AND DEMAND, CRUDE AND PRODUCTS, JANUARY, 1960

(Thousands of barrels)

Source: USA Bureau of Mines, Division of Petroleum.

Country	CRUDE PETROLEUM					REFINED PRODUCTS			
	Production	Imports	Exports and reexports	Stock change, other demand, and loss	Total 1/ refinery input / Total 2/ refinery output	Imports	Exports and reexports	Domestic demand (incl. bunkers) 3/	Bunkers-all flags (as reported)
NORTH AMERICA									
Canada	18,319	9,510	3,805	-411	24,823	2,132	41	4/26,499	
Mexico	8,123	-	-	-14	8,786	533	1,283	8,036	
United States (incl. Alaska)	224,140	28,610	264	-4,173	270,722	30,713	5,734	4/324,828	6,488
Subtotal	250,582	38,120	4,069	-4,598	304,331	33,378	7,058	359,363	
CENTRAL AMERICA AND CARIBBEAN									
Costa Rica	-	-	-	-	-	E/ 98	-	98	
Cuba	16	E/2,000	-	-120	2,136	E/366	-	2,502	
Dominican Republic	-	-	-	-	-	E/165	-	165	
El Salvador	-	-	-	-	-	E/144	-	144	
Guatemala	-	-	-	-	-	E/274	-	274	
Haiti	-	-	-	-	-	E/ 72	-	72	
Jamaica	-	-	-	-	-	562	-	562	E/ 98
Nicaragua	-	-	-	-	-	E/127	-	127	
Panama, Canal Zone	-	-	-	-	-	526	155	371	498
Panama, Republic	-	-	-	-	-	E/265	-	265	
Puerto Rico	-	1,699	-	-300	2,188	497	717	1,968	
Subtotal	16	3,699	-	-420	4,324	3,096	872	6,548	
SOUTH AMERICA									
Argentina	4,251	2,179	-	-155	6,593	966	-	4/6,961	74
Bolivia	269	-	103	-18	184	8	-	192	
Brazil	2,343	E/3,275	E/631	+584	4,803	E/2,722	-	4/9,019	
Chile	564	205	-	-215	1,004	E/595	-	1,599	
Colombia	4,698	-	3,148	-242	2,187	E/ 27	297	4/1,525	E/115
Ecuador	230	252	-	+ 84	398	17	-	415	
Netherlands Antilles	-	24,411	-	+291	26,017	E/1,499	E/22,225	2/5,291	
Paraguay	-	-	-	-	-	E/ 61	-	61	
Peru	1,597	-	175	+ 95	1,344	298	389	1,253	27
Trinidad	3,559	2,298	298	-122	5,715	E/285	E/4,765	2/1,233	938
Uruguay	-	580	-	-211	791	131	E/ 3	893	75
Venezuela	89,243	-	62,181	-1,044	28,304	E/ 71	27,273	4/4,018	1,629
Subtotal	106,974	33,200	66,536	-953	76,940	6,680	54,952	32,422	
WESTERN EUROPE									
Austria	1,425	300	583	-73	1,263	539	125	4/1,437	
Belgium and Luxembourg	-	4,126	-	-264	4,480	E/2,088	E/1,121	5,463	E/111
Denmark	-	-	-	-4	4	3,806	4	3,806	156
Finland	-	427	-	-173	E/600	868	-	1,468	
France	1,114	21,032	3	+ 2,010	20,133	1,412	4,055	4/17,811	1,019
Germany, West	3,232	11,698	-	-940	15,870	2,777	1,019	17,628	315
Greece	-	810	-	-272	1,082	126	-	1,208	
Iceland	-	-	-	-	-	149	-	149	
Ireland	-	616	-	-93	709	343	-	1,052	38
Italy	933	18,075	366	+1,039	18,168	1,462	3,222	4/11,594	1,097
Netherlands	1,084	8,199	-	-1,574	11,814	4,419	6,435	9,798	827
Norway	-	72	-	-	E/ 72	2,385	-	2,457	E/175
Portugal	-	645	-	-312	957	179	10	1,126	
Spain	-	2,190	-	-245	2,494	44	169	2,369	
Sweden	-	2,149	-	+ 514	1,635	11,082	62	12,655	E/247
Switzerland	-	-	-	-	-	2,035	4	2,031	
United Kingdom	47	23,590	-	-1,840	25,477	9,685	9,331	4/29,952	2,898
Yugoslavia	376	416	-	+ 56	736	E/102	E/ 26	812	
Subtotal	8,151	94,345	952	-2,171	105,494	43,507	25,583	122,816	
MIDDLE EAST									
Aden	-	2,719	-	-104	2,823	972	1,768	5/2,027	1,866
Bahrain	1,397	4,467	-	+ 17	5,847	25	5,365	5/307	310
Iran	31,253	-	20,256	-771	11,768	-	8,102	3,666	E/1,493
Iraq	28,028	-	E/26,892	-	E/1,136	E/ 1	-	1,137	
Israel	76	E/818	-	-	894	E/898	-	1,792	E/ 31
Jordan	-	-	-	-	-	E/ 96	-	96	
Kuwait	49,084	-	43,458	+1,022	4,604	-	2,449	5/2,155	1,904
Lebanon	-	467	-	-	467	E/ 28	-	495	E/ 67
Neutral Zone	3,919	-	E/3,200	-481	E/1,200	-	E/500	5/700	E/250
Qatar	5,620	-	E/5,602	-	E/ 18	-	-	18	
Saudi Arabia	37,856	-	32,347	-653	6,162	2	3,596	2,015	E/1,060
Turkey	223	-	-	+ 17	206	341	-	547	
U.A.R., Syria	-	E/457	-	-	E/457	30	-	487	
Subtotal	157,456	8,928	131,755	-953	35,582	2,393	21,780	15,642	
AFRICA									
Algeria	3,518	-	3,131	+ 387	-	518	-	5/638	
Angola	32	E/ 50	-	-	82	86	-	168	
Belgian Congo	-	-	-	-	-	54	-	54	
Canary Islands	-	1,678	-	-13	2,182	50	1,348	5/884	430
Ethiopia	-	-	-	-	-	E/ 57	-	57	
States formerly in French Equatorial Africa	474	-	389	+ 85	-	E/178	-	178	
French West Africa	-	-	-	-	-	E/341	-	341	E/660
Ghana	-	-	-	-	-	E/214	-	214	
Kenya	-	-	-	-	-	E/587	E/ 94	493	E/ 76
Liberia	-	-	-	-	-	E/ 32	-	32	
Madagascar	-	-	-	-	-	39	-	39	
Morocco	62	E/ 68	-	-	130	377	-	5/471	E/ 42
Nigeria	682	-	474	+ 208	-	493	-	493	
Rhodesia & Nyasaland	-	-	-	-	-	E/331	-	331	
Sudan	-	-	-	-	-	247	-	247	
Tanganyika	-	-	-	-	-	E/370	E/ 37	333	
Tunisia	-	-	-	-	-	403	-	5/283	
Uganda	-	-	-	-	-	E/ 98	E/ 15	83	
Union of South Africa	-	1,097	-	+ 253	844	1,501	135	2,210	
U.A.R., Egypt	1,765	E/1,000	347	-82	E/2,500	E/596	E/123	2,973	185
Subtotal	6,533	3,893	4,341	+ 838	5,738	6,572	1,752	10,522	
SOUTH ASIA, FAR EAST, AND OCEANIA									
Australia	-	7,464	-	+ 625	6,847	472	719	6,600	E/632
British Borneo	3,184	-	1,665	-	E/1,519	E/ 77	1,213	383	98
Burma	321	-	-	+ 100	E/221	E/ 9	E/ 3	227	
Ceylon	-	-	-	-	-	409	-	409	181
India	264	E/3,295	-	-	E/3,559	1,400	205	4,754	E/240
Indonesia	12,126	E/550	5,895	-247	E/7,518	E/ 52	1,628	5,942	40
Japan	279	15,605	-	+ 109	14,775	1,873	403	16,245	
Korea, South	-	-	-	-	-	E/445	-	445	
Malaya and Singapore	-	-	173	-173	-	3,134	1,381	1,753	1,043
Netherlands New Guinea	129	-	E/129	-	-	-	-	Insig.	
New Caledonia	-	-	-	-	-	E/ 34	-	34	
New Zealand	-	-	-	-	-	952	-	952	E/130
Pakistan	183	-	-	- 34	E/217	E/896	-	1,113	
Philippines	-	899	-	+ 152	747	E/859	-	1,606	E/ 11
Taiwan	1	618	-	+ 80	539	E/278	7	810	
Thailand	-	-	-	-	-	556	-	556	52
Vietnam, South (incl. Cambodia)	-	-	-	-	-	E/461	-	461	E/ 3
Subtotal	16,487	27,431	7,862	+ 612	35,942	11,907	5,559	42,290	
WORLD TOTAL EXCLUDING EASTERN EUROPE, U.S.S.R., & MAINLAND CHINA	546,199	209,616	215,515	-7,645	568,351	107,533	117,556	589,603	

E/ Estimate based on latest available data.
1/ Total input includes crude runs to stills plus runs of other unfinished oils, topped crude and natural gas liquids blended.
2/ Total output includes refined product output plus refinery fuel and loss; excludes liquefied petroleum gases sold directly for fuel and chemical uses from natural gasoline plants.
3/ Unless otherwise specified, data represent apparent domestic demand (including inland demand, refinery fuel and loss, and bunkers). Apparent domestic demand is derived from the components of refined product output, plus imports, minus exports, with no allowance for changes in stocks.
4/ Domestic demand as reported, including refinery fuel and loss, stock changes, and bunkers; also includes, where available, liquefied petroleum gases sold directly for fuel and chemical uses from natural gasoline plants.
5/ Apparent domestic demand is heavily influenced by refinery fuel and loss, and bunker loadings.

(*Continued from page 85*)

SWITZERLAND—Rerouting of the Swiss section of the proposed Genoa-Munich crude pipeline (which originally was to go via Aigle) seems imminent with the signing by ENI (Italian State oil agency) and the Swiss cantons of Graubuden and Ticino of an agreement to reroute the line via Bellinzona (Ticino) and through the upper Rhine valley. In the event a refinery should be built in Ticino, the line would tap this southeastern Swiss area.

SWITZERLAND—The Swiss central government has announced abandonment of its plan to amend Switzerland's constitution to give it control of the nation's oil rights, which control will remain with the provinces or cantons; and the cantons have decided they will not grant oil concessions to foreign-controlled companies.

TIMOR (Portuguese)—The American firm Tradewinds Exploration (a Sunset International affiliate) resumed drilling in Timor in September with a test well on the south coast of the Southwest Pacific island. Partner in the venture with Tradewinds is the Australian firm Timor Oil Ltd.

TUNISIA—Renewal of the permit held by the French firm SEREPT in the extreme south of the country (in which Mobil obtained a half-interest during 1959) awaits approval by the Tunisian assembly. The initial period ended September 10. Acreage has been selected for surrender under the oil law, which requires that 20% of the 16,200 square miles involved be returned to the government.

TURKEY—Esso Standard (Turkey), an SONJ affiliate, has announced discontinuance of exploration activities in Turkey after six unsuccessful years of oil search and an expenditure of $20 million. It will turn over all geological and drilling data to the Turkish government.

TURKEY—Mobil International now reports the indicated yield of its exploratory well Bulgurdag No. 1 (near Mersin) has increased to 1,200 b/d from the initial 240 b/d (see *WPR* 8-15-60). After treatment, the well flowed 38.9-gravity low-sulfur crude, without water, through a ⅜-in. choke.

U.A.R. (Syria)—Agip Mineraria, affiliated with the Italian State-owned ENI, has obtained Syrian rights for "preliminary" geological exploration in the Central Desert of central and southern Syria between the Euphrates River, Homs, and Damascus. It is reported this preliminary grant was obtained on news of probable changes in Syria's oil laws, and followed Cairo reports that plans are under way to open parts of Syria to international bids for oil rights similar to those recently issued for Egypt's Western Desert.

"Excellent . . . enriches the literature of world Petroleum history . . ." **Dr. C. P. de la Cova**, Venezuelan Petroleum Minister to the U. S.

THE FIRST BIG OIL HUNT VENEZUELA, 1911-1916

by RALPH ARNOLD, GEORGE A. MACREADY and THOMAS W. BARRINGTON

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(To be fair we should point out that the domed top and fabricated cantilever are part of a test rig. The thing in question begins at the weld below the lettering).

Unless you happened to see, in an earlier advertisement, the cardboard model in which the idea took shape, memory will be no help. This is something quite new.

It is an expansion joint, one of 72 such joints that will take up the expansion of the CO_2 ducting at the Trawsfynydd Atomic Power Station. Internal pressure 265 p.s.i., temperature 420° C.

The convoluted bellows holds the internal pressure; the end thrust—over 1,000,000 lb.—is taken by the inclined, high-tensile steel bars round the periphery; flexing is entirely by elastic straining of these bars. The illustration shows the joint being prepared for the Insuring Authority's acceptance test—1,250 full deflections under full internal pressure and temperature. Compared with previous joints for this kind of work it is lighter, simpler, cheaper. It is the kind of highly original solution to both new and old problems that Richardsons Westgarth engineers can, and frequently do, produce.

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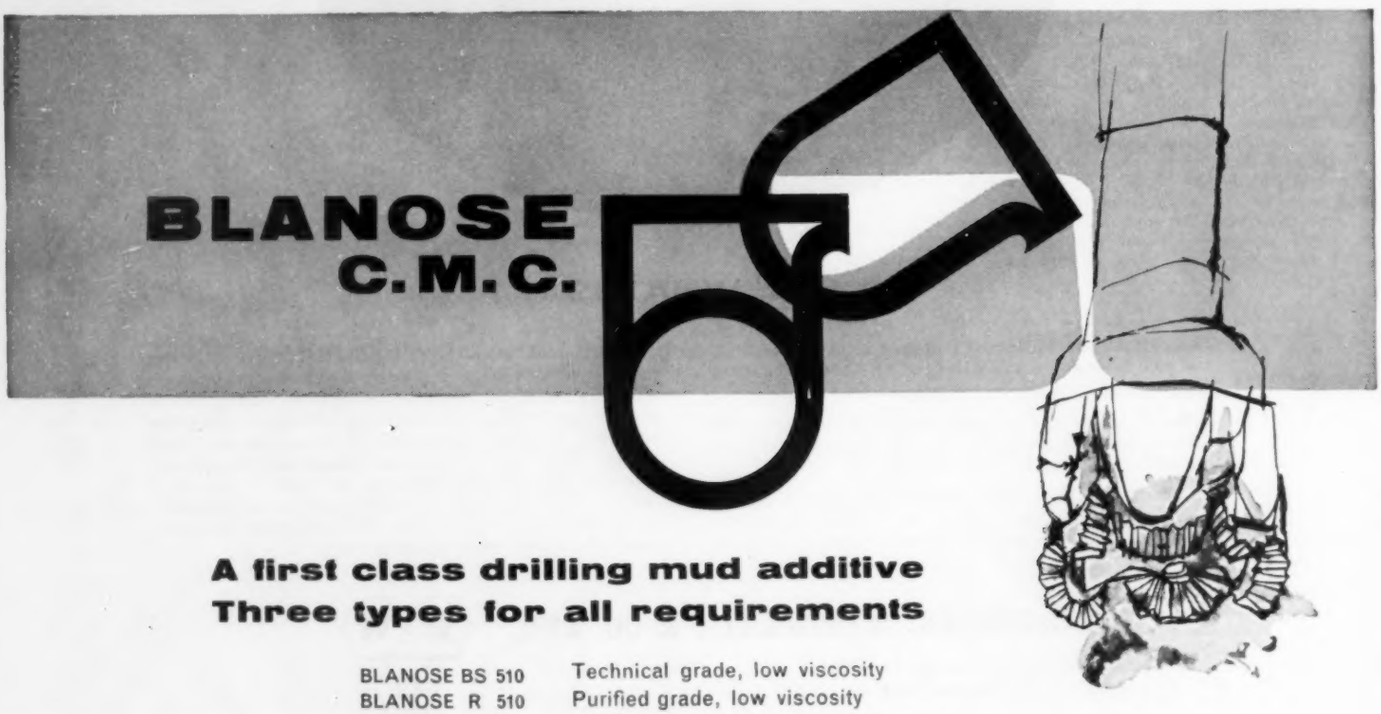

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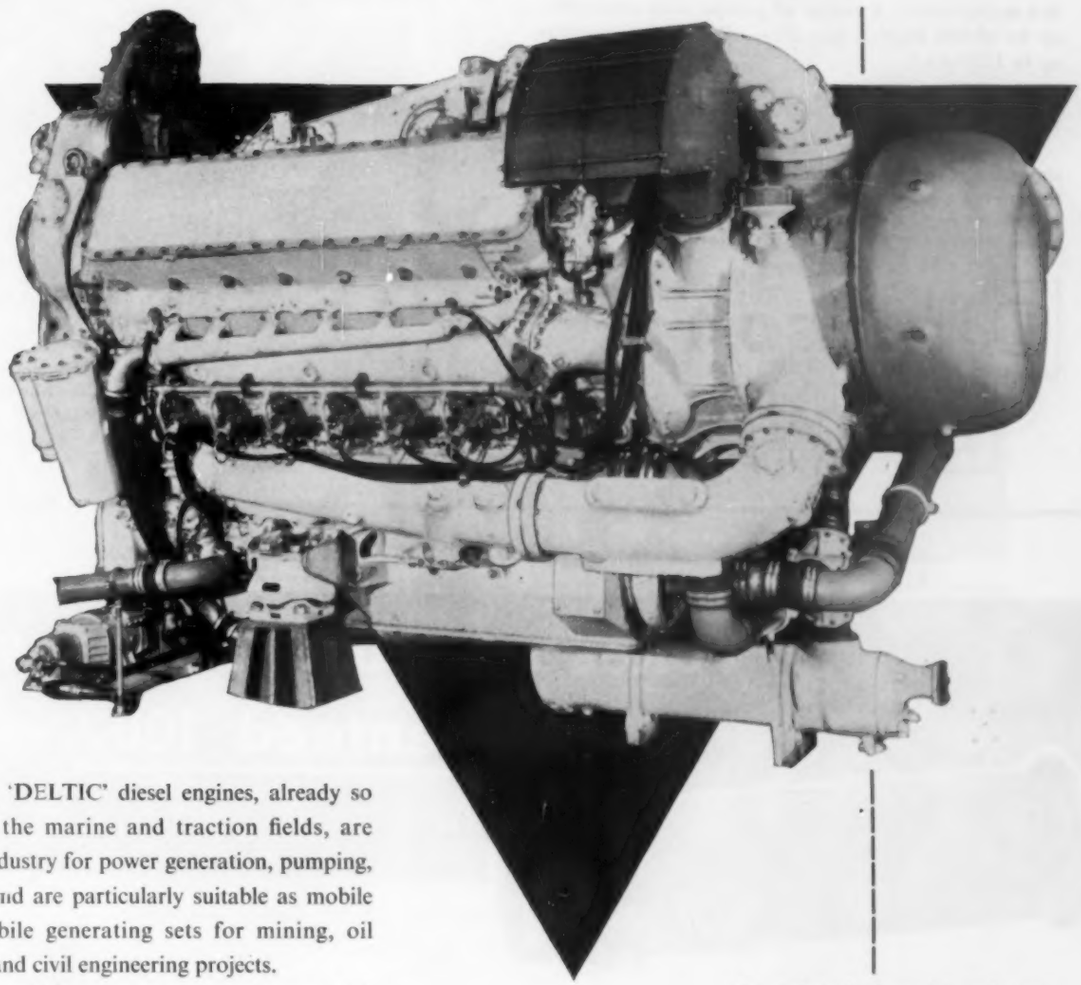

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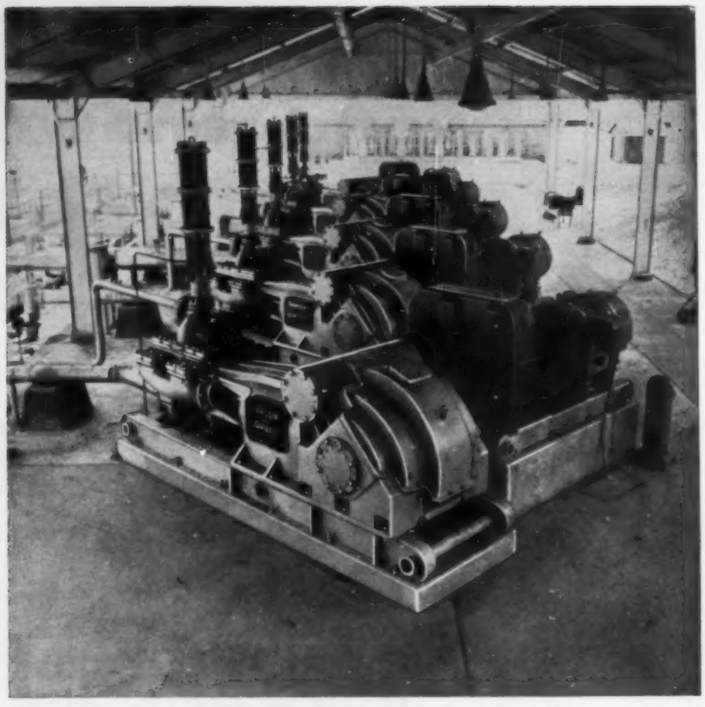

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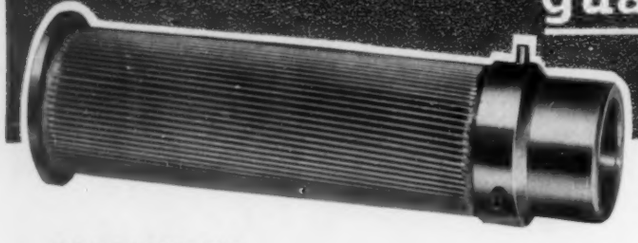

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The unique combination of properties found in Poroloy CM has led to its recent use in critical temperature conditions in the United States missile and aircraft industries, including installation in the Boeing 707.

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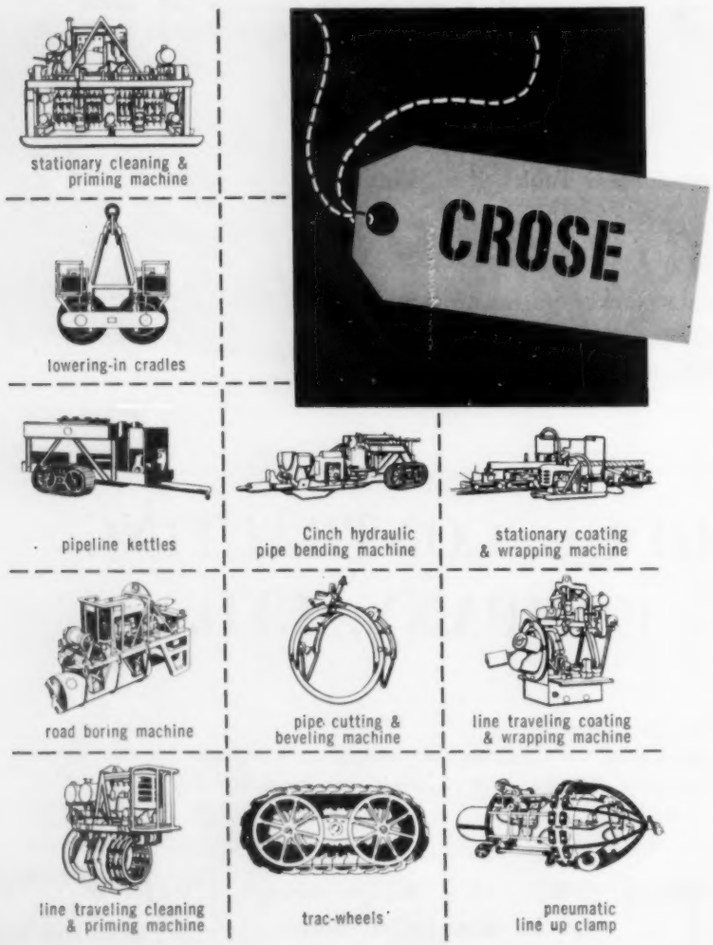

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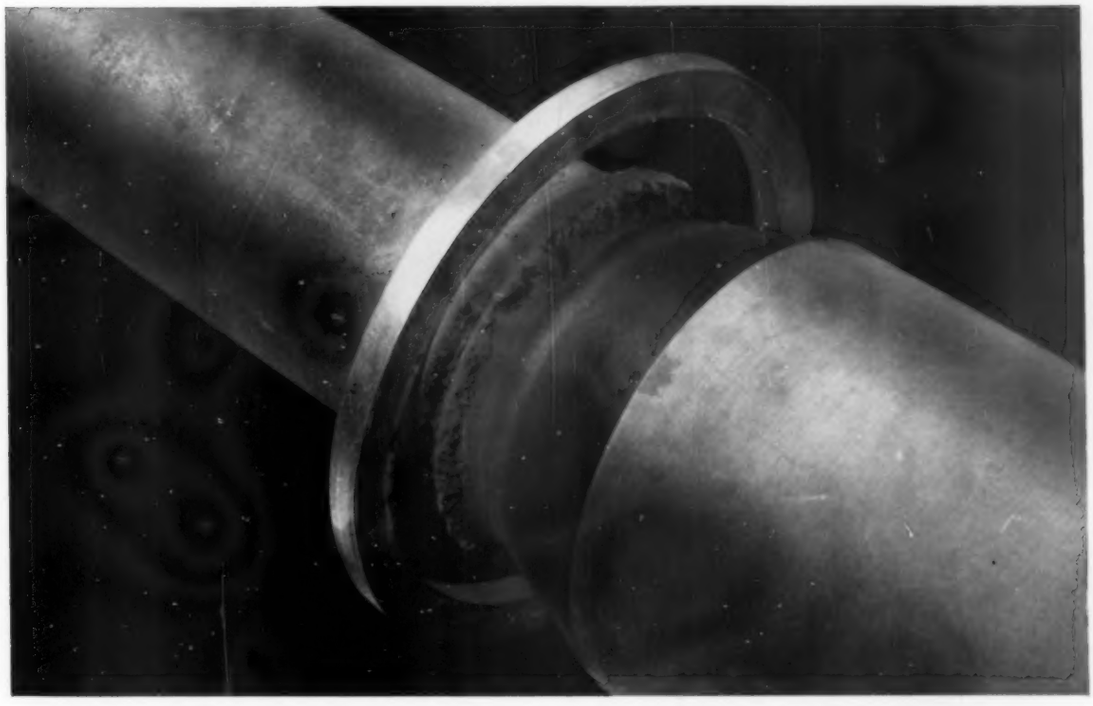

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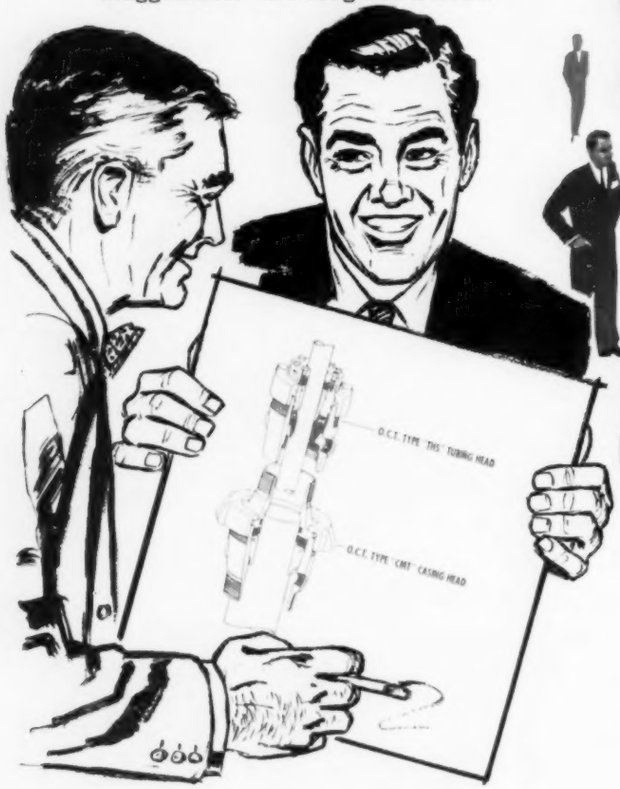

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